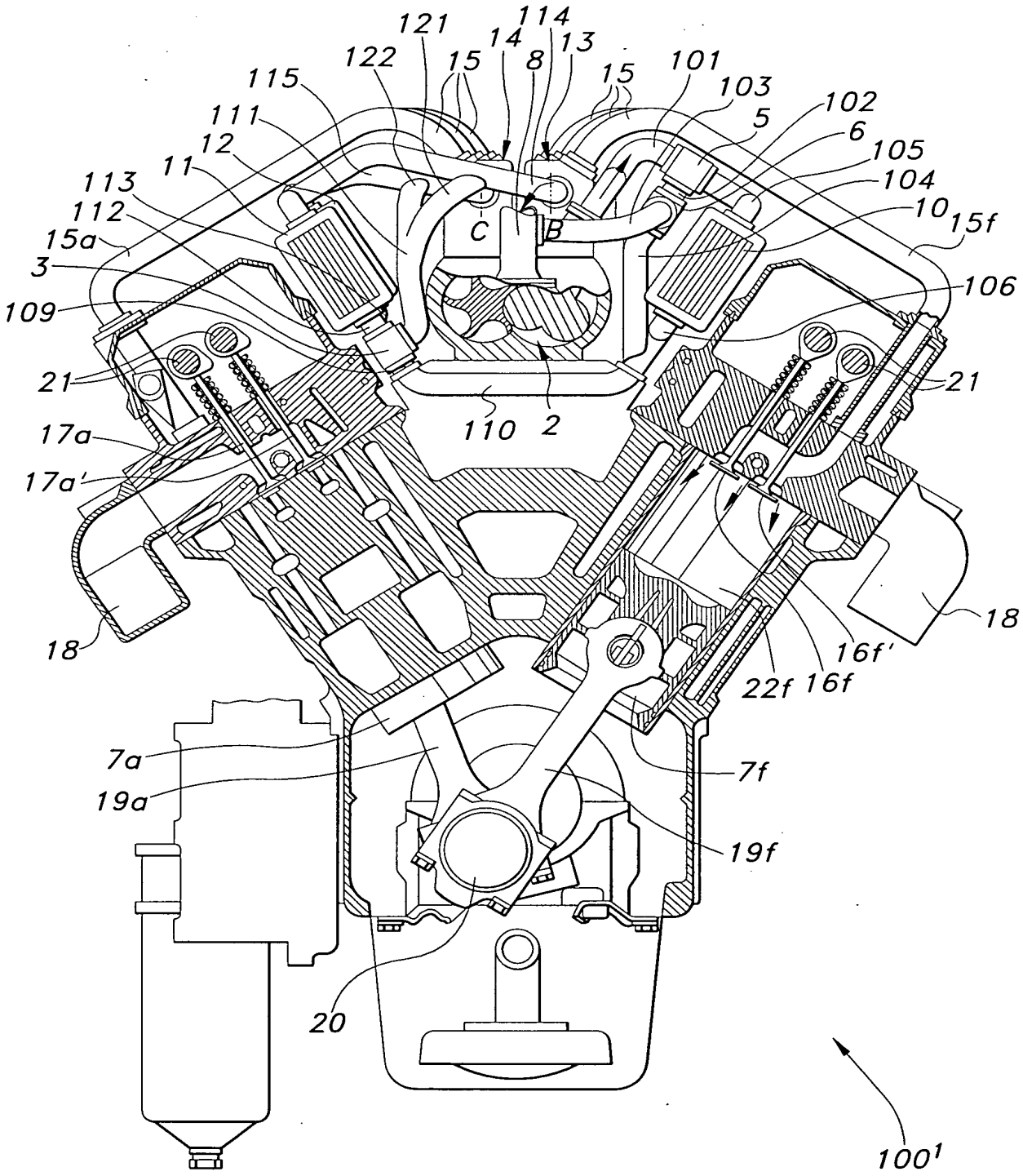


FIG 1

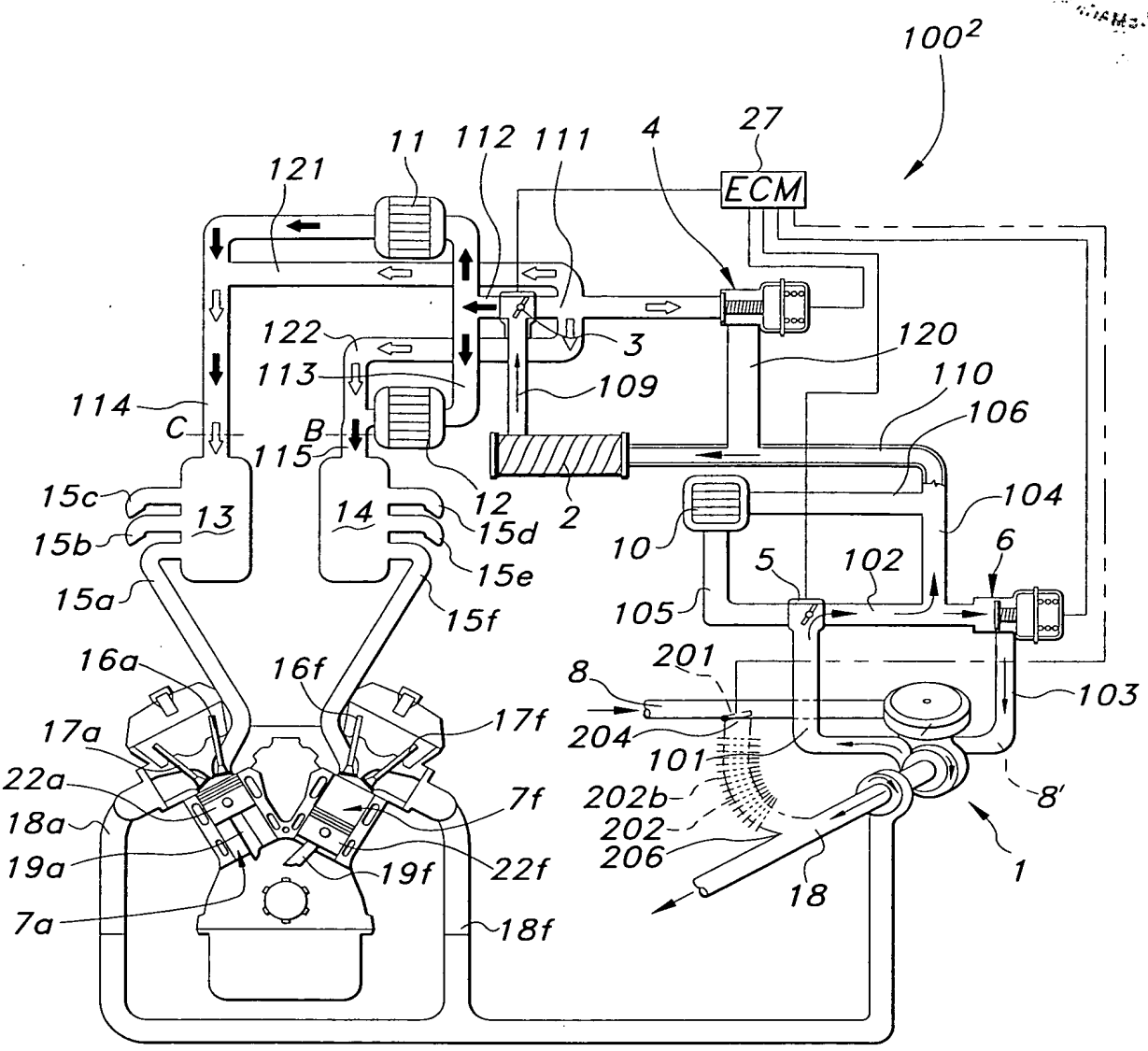


FIG 2

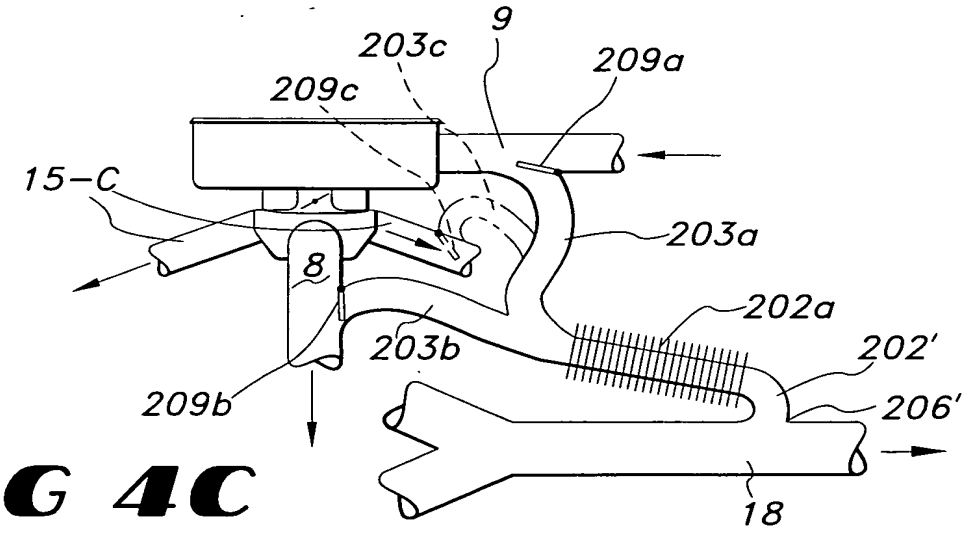


FIG 4C

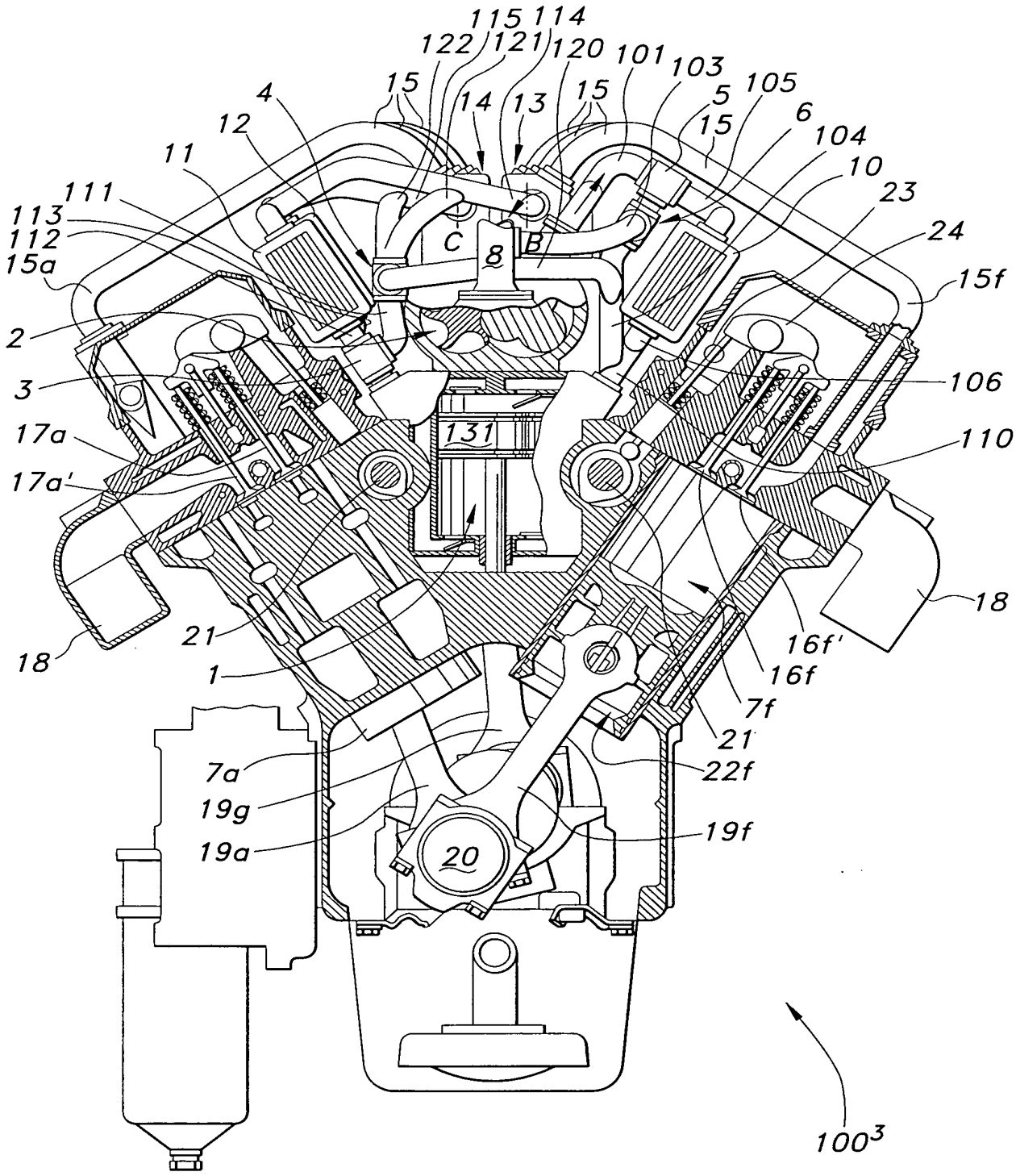


FIG 3

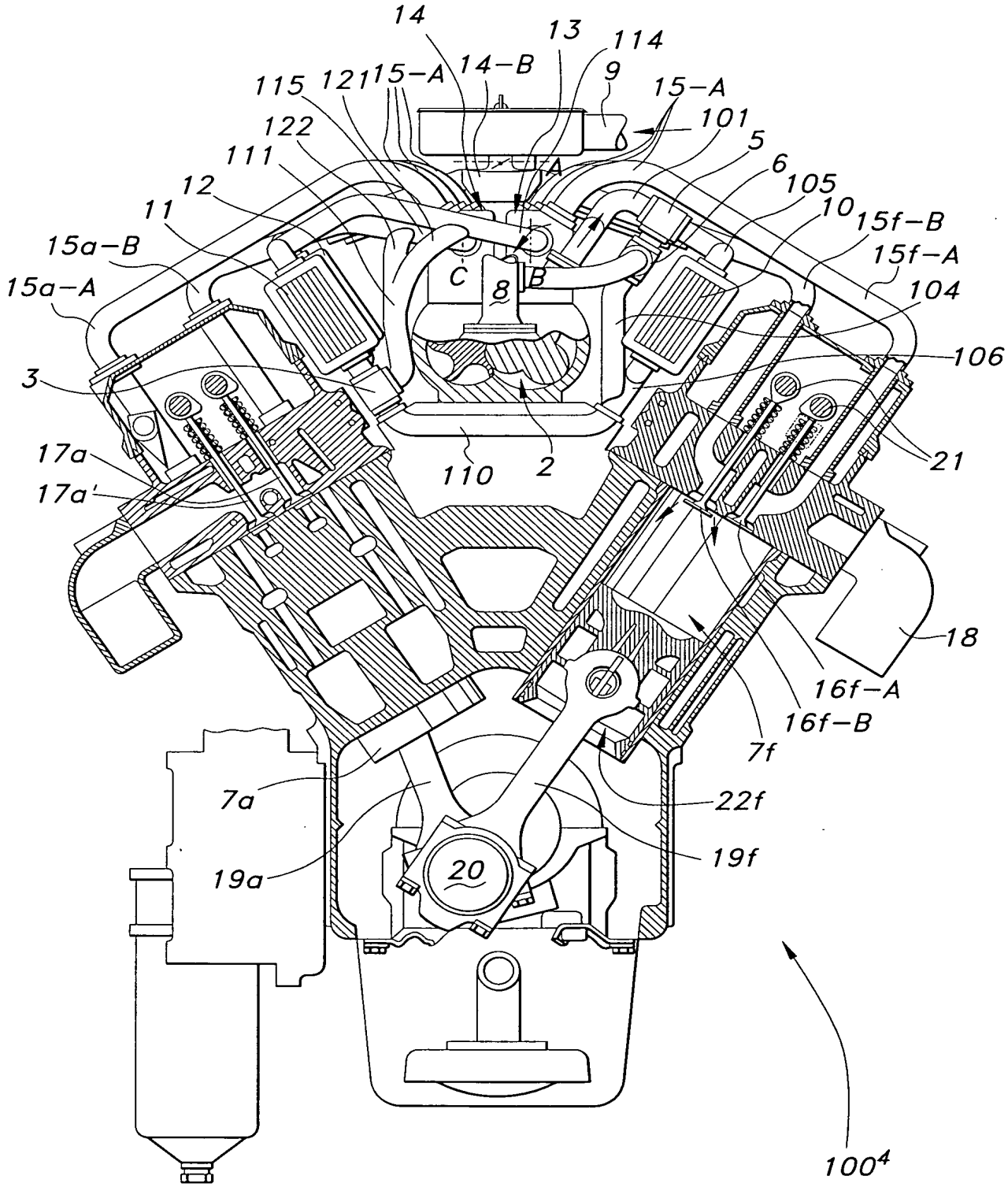


FIG 4

4B

123 559.1

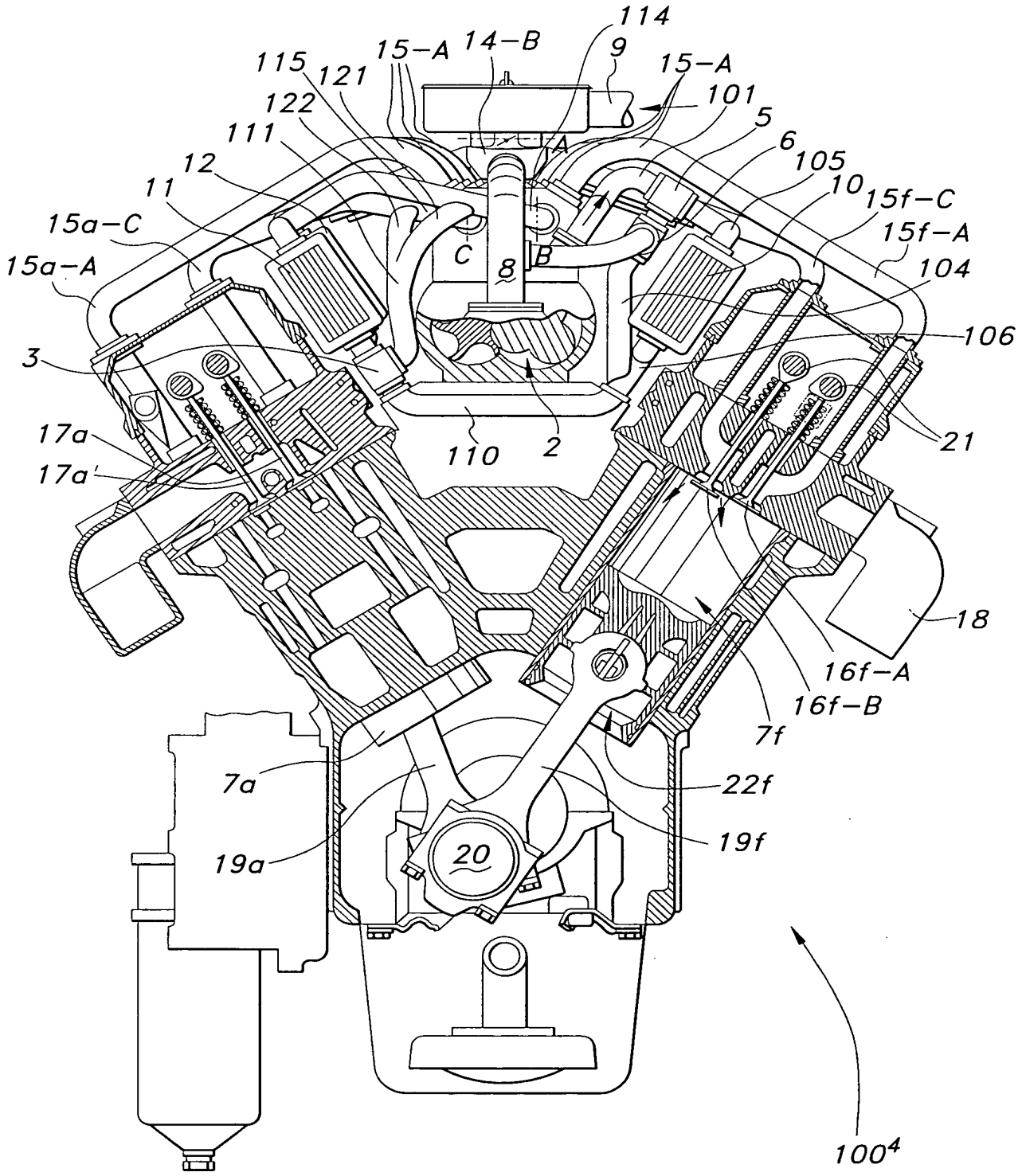


FIG 4B

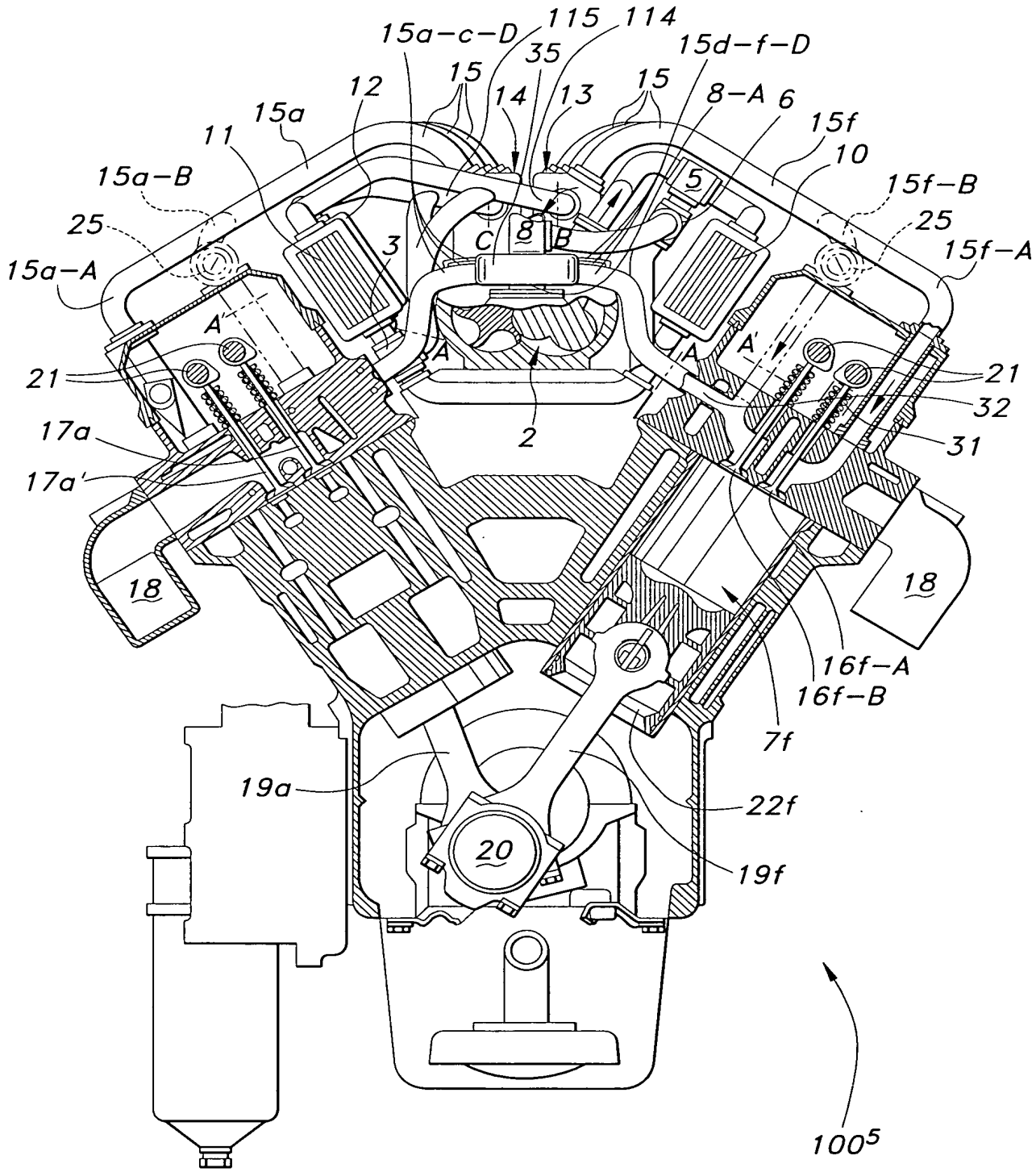

15a-c-D
115
114
15d-f-D
35
15
12
14
13
15
8-A
6
15a
11
15f
10
15a-B
5
15f-B
25
25
15f-A
15a-A
3
C
8
B
A'
A
A
A'
21
21
32
2
17a
31
17a'
18
18
16f-A
16f-B
7f
19a
22f
20
19f
100⁵

FIG 5

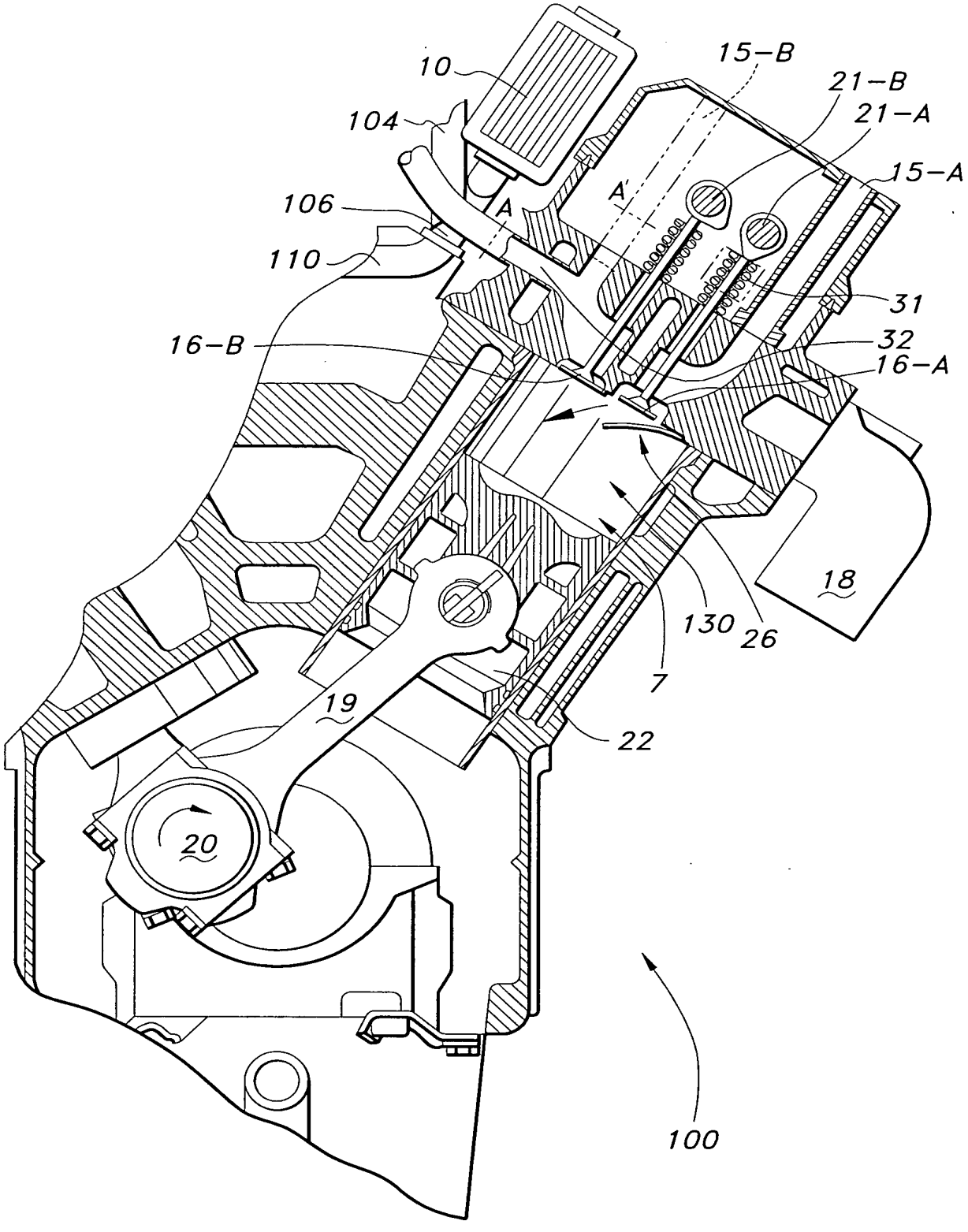

10
15-B
21-B
21-A
104
15-A
A
A'
106
110
31
16-B
32
16-A
18
130
26
7
19
22
20
100

FIG 6

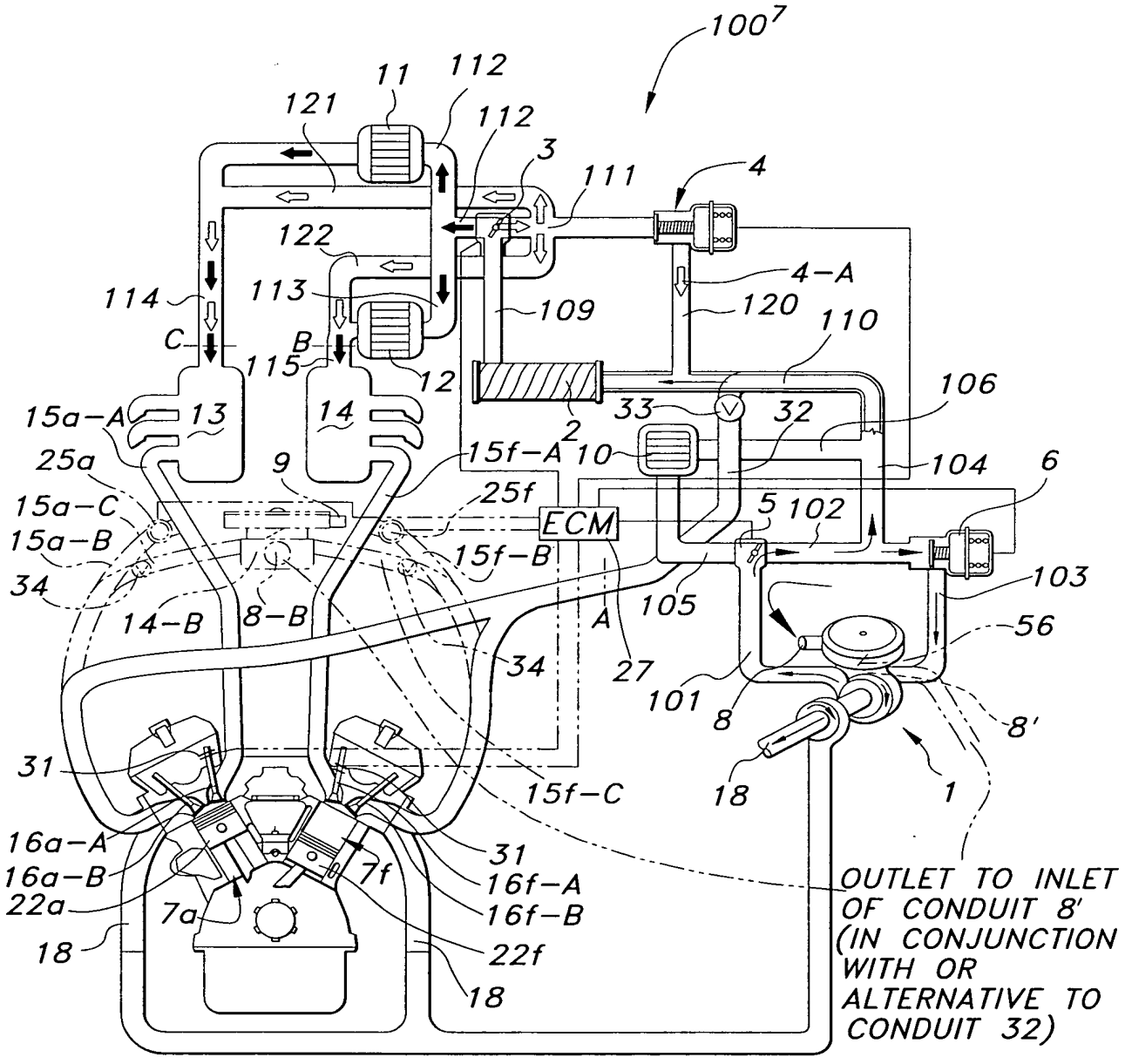

100
11
112
121
112
3
111
4
122
4-A
114
113
109
120
110
C
B
115
12
106
15a-A
13
14
33
32
2
25a
9
15f-A
10
104
6
15a-C
25f
ECM
5
102
15a-B
15f-B
103
34
14-B
8-B
A
105
56
34
27
101
8
8'
31
15f-C
18
1
16a-A
31
16a-B
7f
16f-A
22a
7a
16f-B
18
22f
18
OUTLET TO INLET OF CONDUIT 8' (IN CONJUNCTION WITH OR ALTERNATIVE TO CONDUIT 32)

FIG 7

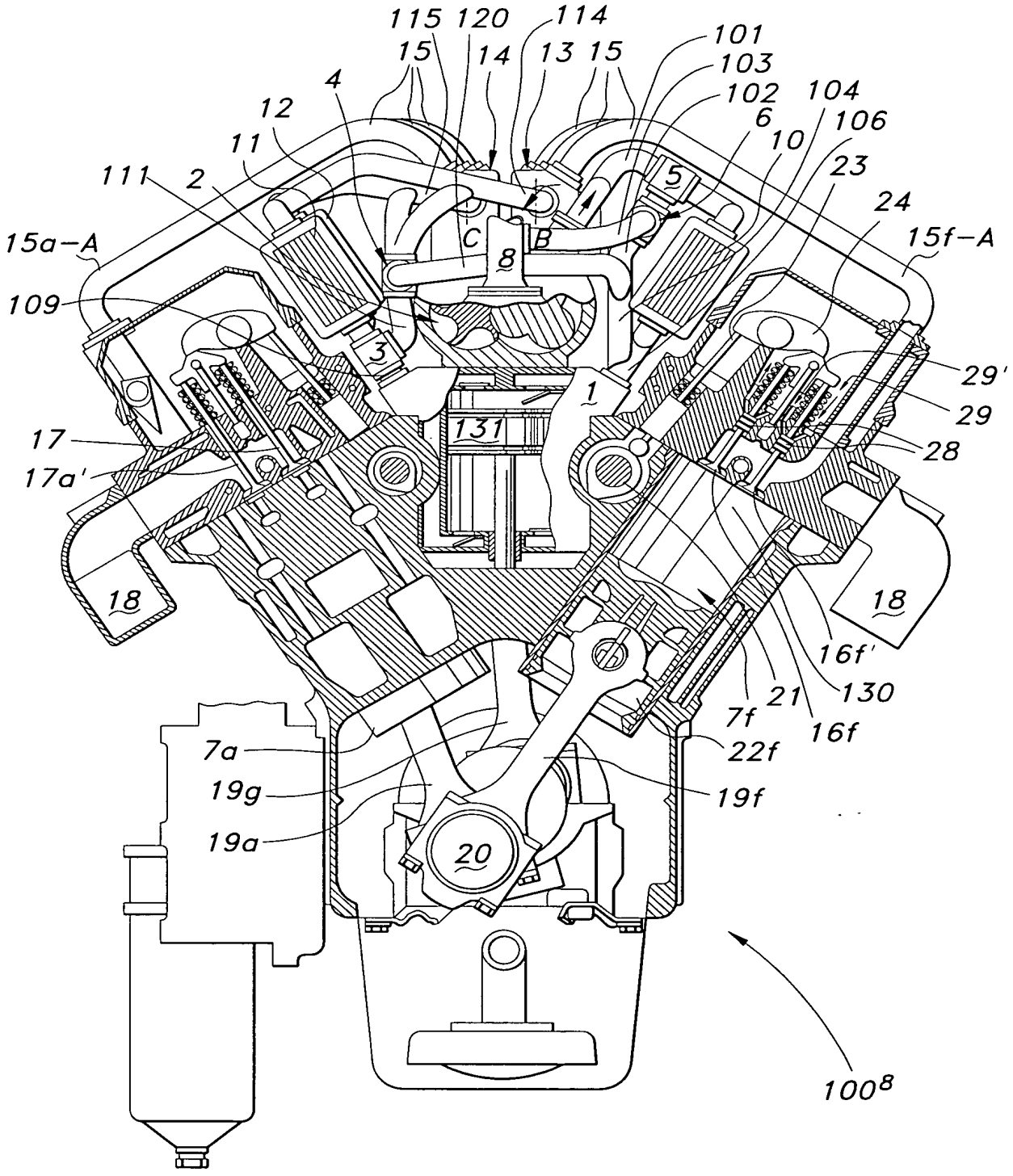

115
120
114
15
14
13
15
101
103
102
104
106
6
10
23
24
12
4
11
111
2
5
15a–A
15f–A
C
8
B
109
3
1
29'
29
131
28
17
17a'
18
18
16f'
130
21
7f
16f
22f
7a
19g
19a
19f
20
100⁸

FIG 8

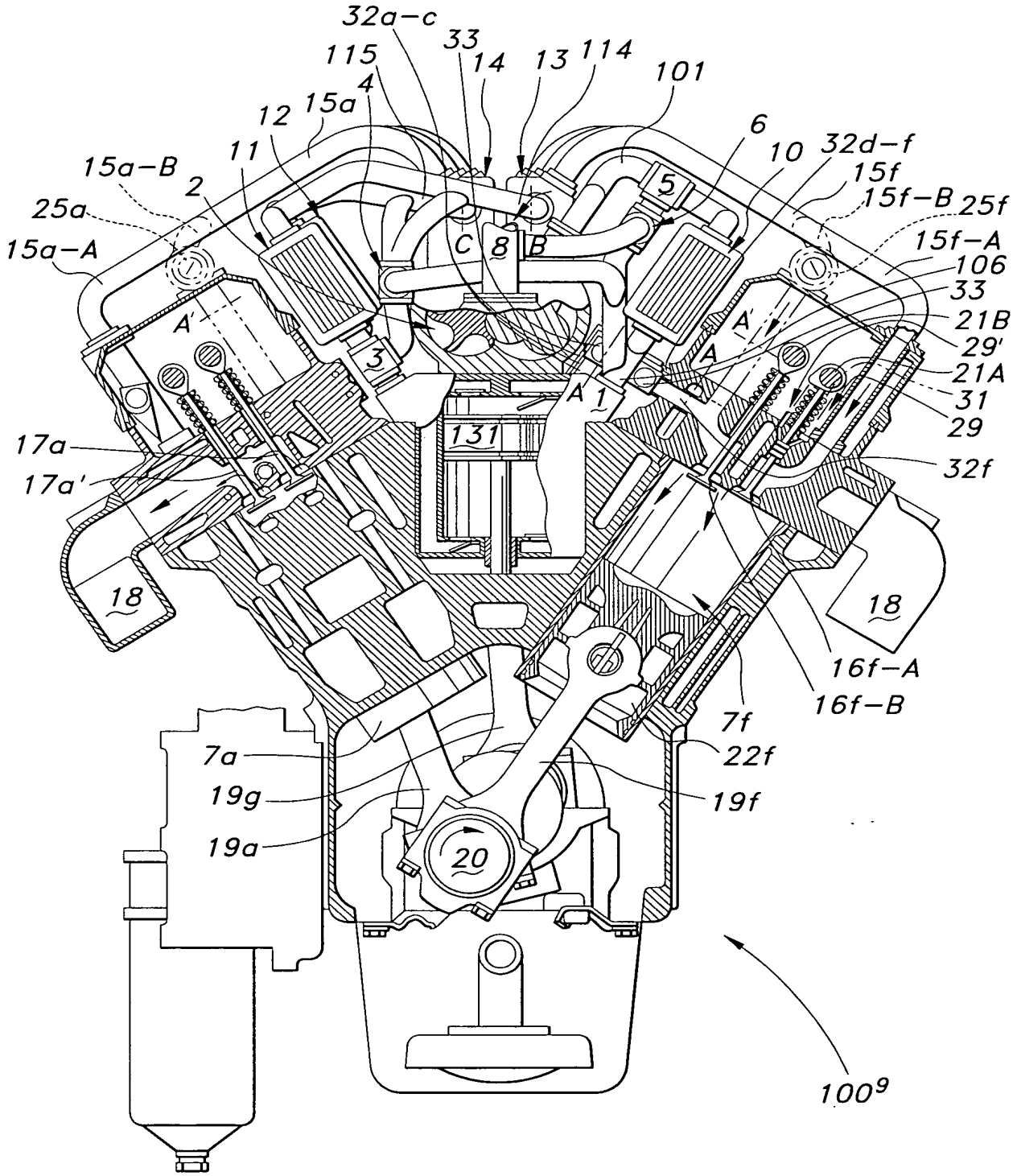

32a–c
33
115
14
13
114
101
4
12
15a
11
6
10
32d–f
15f
15a–B
2
5
15f–B
25f
25a
15a–A
C
8
B
15f–A
106
33
A'
A
21B
29'
3
21A
A
1
31
131
29
17a
32f
17a'
18
18
16f–A
16f–B
7f
7a
22f
19g
19f
19a
20
100⁹

FIG 9

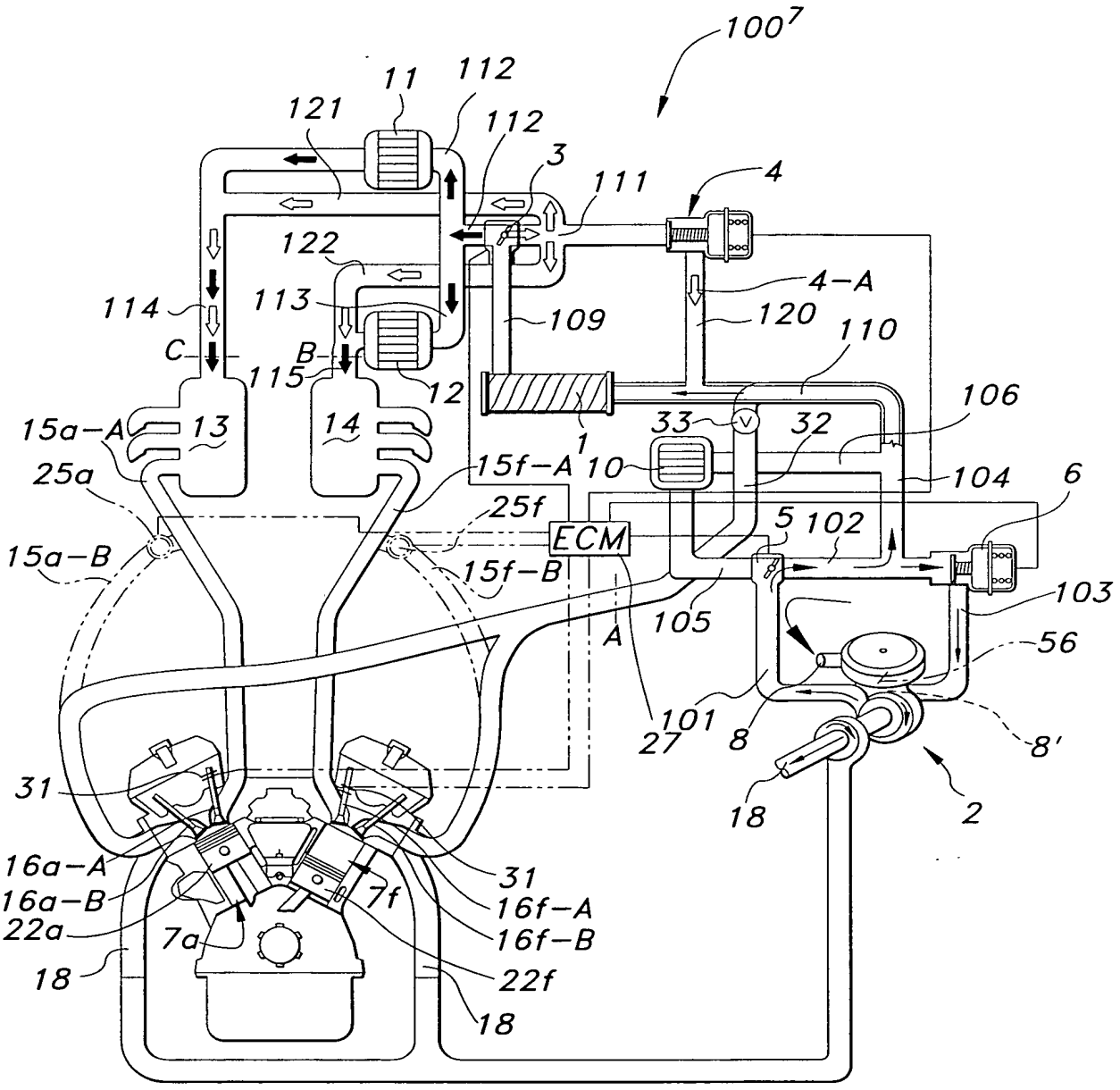

100
11
112
112
121
3
111
4
122
4-A
114
113
109
120
110
C
B
115
12
106
15a-A
13
14
33
32
1
25a
15f-A
10
104
6
25f
ECM
5
102
15a-B
15f-B
103
105
A
56
27
101
8
8'
31
18
2
16a-A
31
16a-B
7f
16f-A
22a
7a
16f-B
18
22f
18

FIG 9B

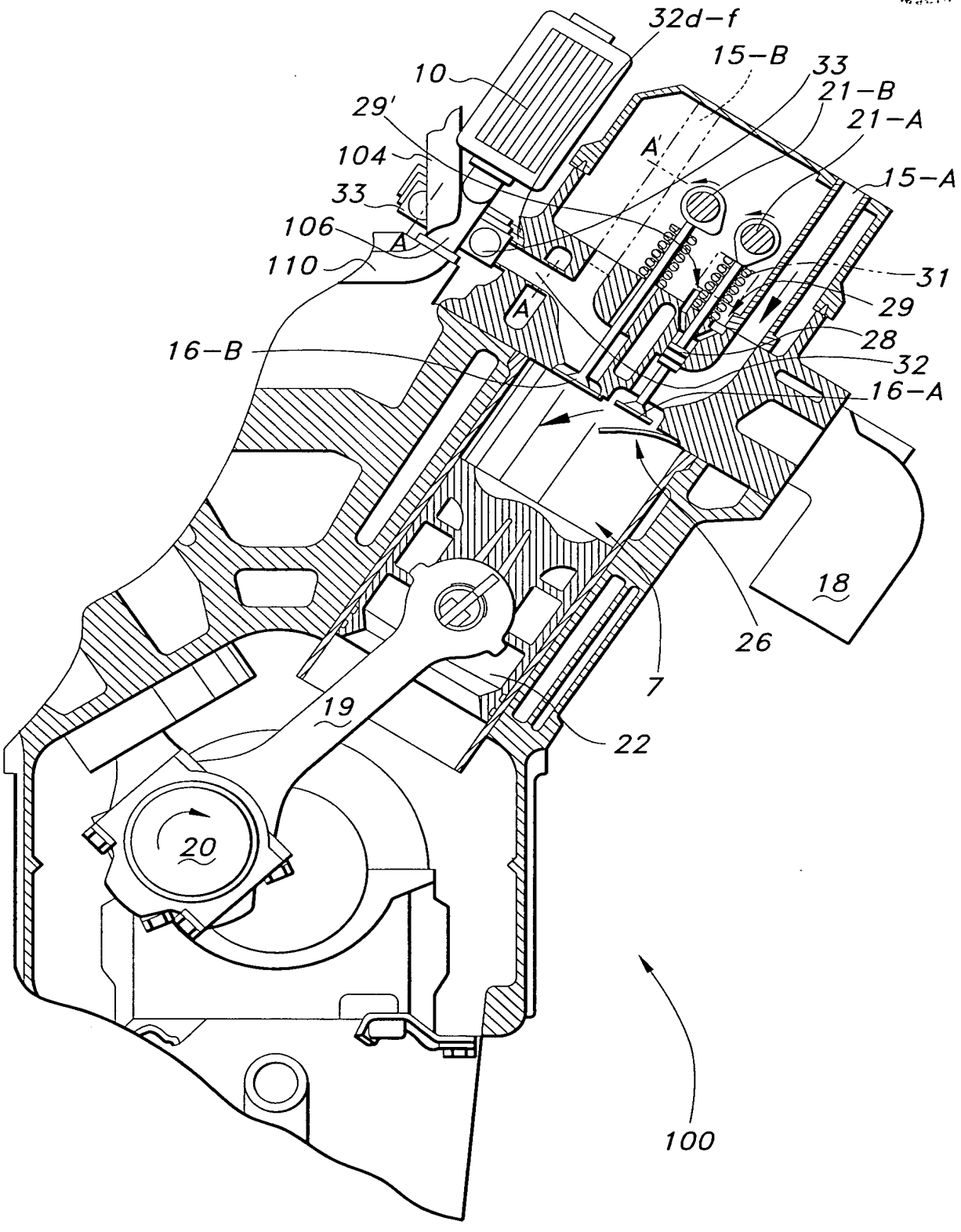

32d–f
15–B
33
21–B
21–A
10
29'
104
A'
15–A
33
106
A
110
31
A
29
28
16–B
32
16–A
18
26
7
19
22
20
100

FIG 10

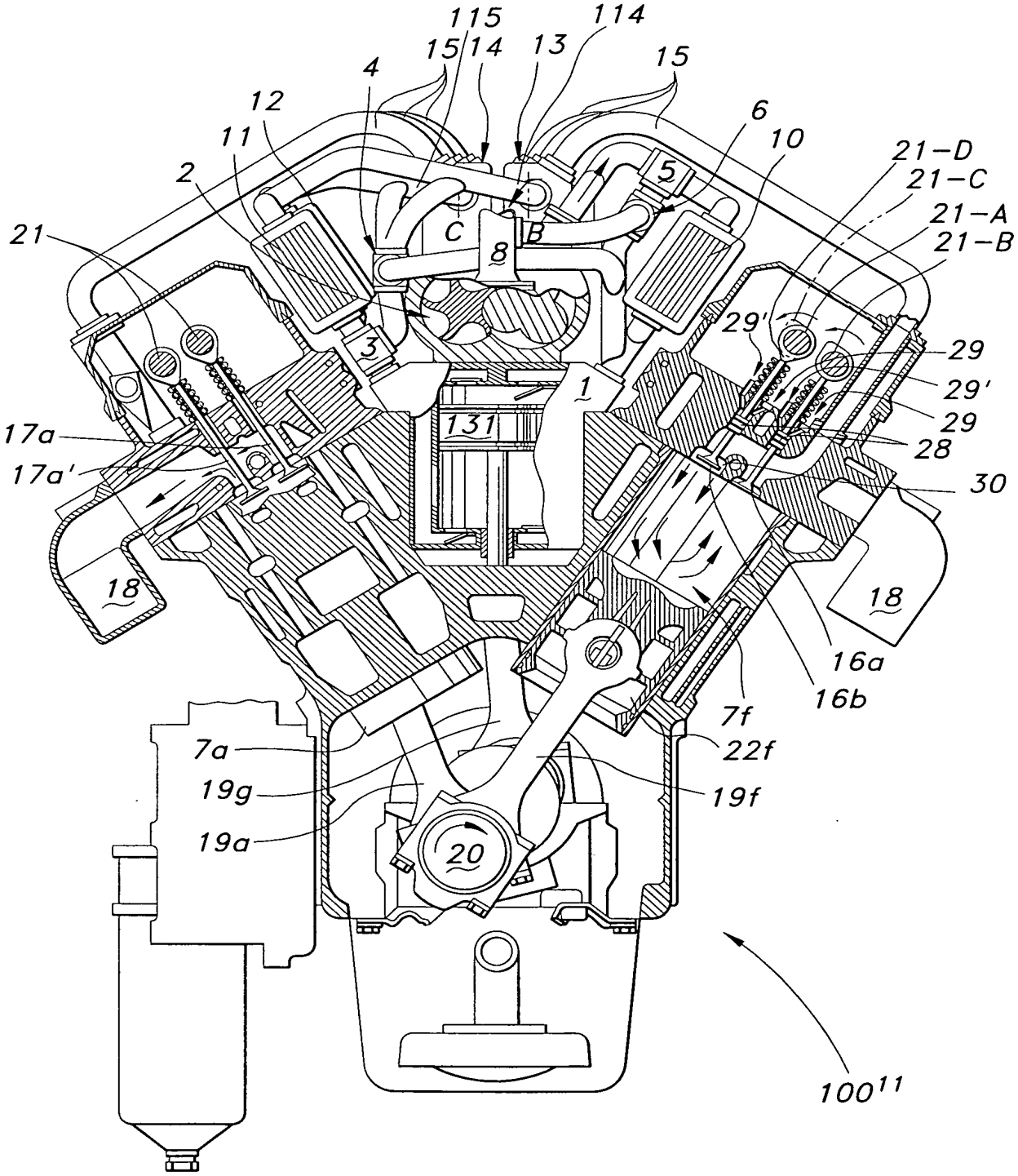
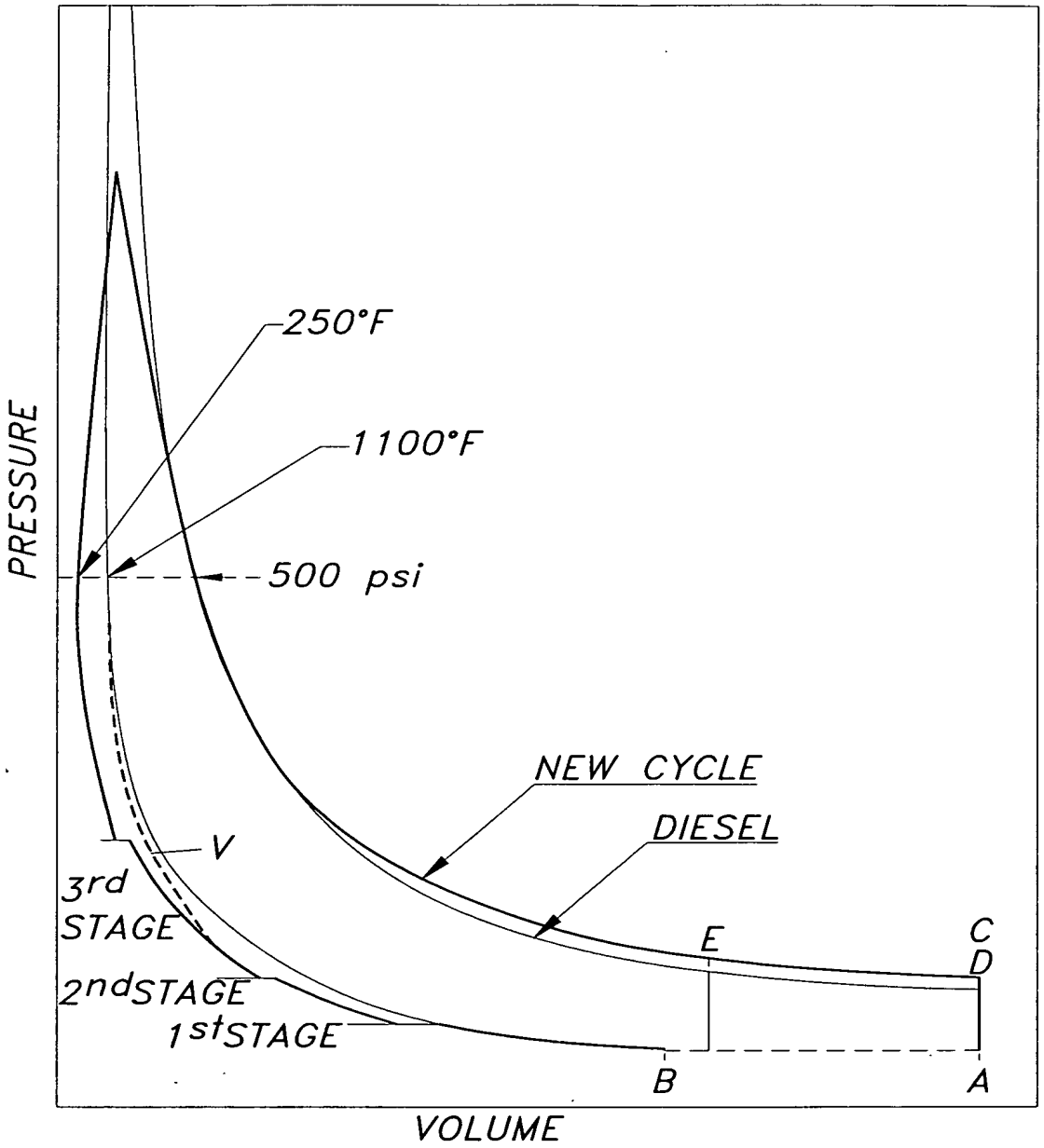

115
15
14
13
114
15
4
12
11
2
6
10
21-D
21-C
21-A
21-B
21
5
C
8
B
29'
29
29'
29
28
30
3
1
131
17a
17a'
18
18
16a
16b
7f
22f
19f
7a
19g
19a
20
100 11

FIG 11



A – COMPRESSION BEGINS IN 2–STROKE AND 4–STROKE DIESEL CYCLE ENGINE

B – COMPRESSION BEGINS IN 2–STROKE AND 4–STROKE NEW CYCLE ENGINE

C – EXPANSION ENDS IN 4–STROKE DIESEL CYCLE ENGINE

D – EXPANSION ENDS IN 2–STROKE AND 4–STROKE NEW CYCLE ENGINE

E – EXPANSION ENDS (AT EXHAUST BLOW–DOWN) IN 2–STROKE DIESEL CYCLE ENGINE

V – SEE NOTE 1 IN DESCRIPTION

FIG 12

COMPARISON OF OPERATING PARAMETERS OF A HEAVY DUTY TWO-STROKE DIESEL ENGINE (A)

WITH THE ENGINE OF THIS INVENTION (B)

ENGINE	COMPRESSION RATIO OR NOMINAL COMPRESSION RATIO	EFFECTIVE COMP RATIO	COMPRESSION PRESSURE (PSI)	TEMP @ END COMP (DEG F.)	TEMP @ END COMB (DEG F.)	CHARGE DENSITY (LB./CU. FT.)	EXPANSION RATIO	E. R. / C. R.	CHARGE WEIGHT PER REVOLUTION (GRAMS)
A	19:1	19:1	907	1300	3400	1.45	*10:1	0.5	2.06
B(ic)	13:1	2:1	533	250	3000	2.03	**19:1	1.5	2.86
B(bp)	13:1	13:1	533	992	^3100	1.01	**19:1	1.5	1.43
B2(ic)	10:1	2:1	369	250	^2800	1.40	**19:1	1.9	1.98
B2(bp)	10:1	10:1	369	871	^2900	0.75	**19:1	1.9	1.06

* Exhaust valve opens midstroke
** Exhaust valve opens near BDC
(ic) Air charge intercooled except for last stage of compression
(bp) Intercoolers bypassed
^ Estimated

$$\frac{\text{E. R.}}{\text{C. R.}} = \frac{\text{EXPANSION RATIO}}{\text{COMPRESSION RATIO}}$$

FIG 13

COMPARISON OF OPERATING PARAMETERS OF A HEAVY DUTY FOUR-STROKE DIESEL ENGINE (A)

WITH THE ENGINE OF THIS INVENTION (B)

ENGINE	COMPRESSION RATIO OR NOMINAL COMPRESSION RATIO	EFFECTIVE COMP RATIO	COMPRESSION PRESSURE (PSI)	TEMP @ END COMP (DEG F.)	TEMP @ END COMB (DEG F.)	CHARGE DENSITY (LB./CU. FT.)	EXPANSION RATIO	E. R. / C. R.	CHARGE WEIGHT PER REVOLUTION (GRAMS)
A	19:1	19:1	907	1300	3400	1.45	19:1	1.0	*1.03
B(ic)	13:1	2:1	533	250	3000	2.03	19:1	1.5	**2.86
B(bp)	13:1	13:1	533	992	^3100	1.01	19:1	1.5	**1.43
B2(ic)	10:1	2:1	369	250	^2800	1.40	19:1	1.9	**1.98
B2(bp)	10:1	10:1	369	871	^2900	0.75	19:1	1.9	**1.06

* Per revolution, not per firing stroke
** Per revolution and per firing stroke
(ic) Air charge intercooled except for last stage of compression
(bp) Intrecoolers bypassed
^ Estimated

$$\frac{\text{E. R.}}{\text{C. R.}} = \frac{\text{EXPANSION RATIO}}{\text{COMPRESSION RATIO}}$$

FIG 14

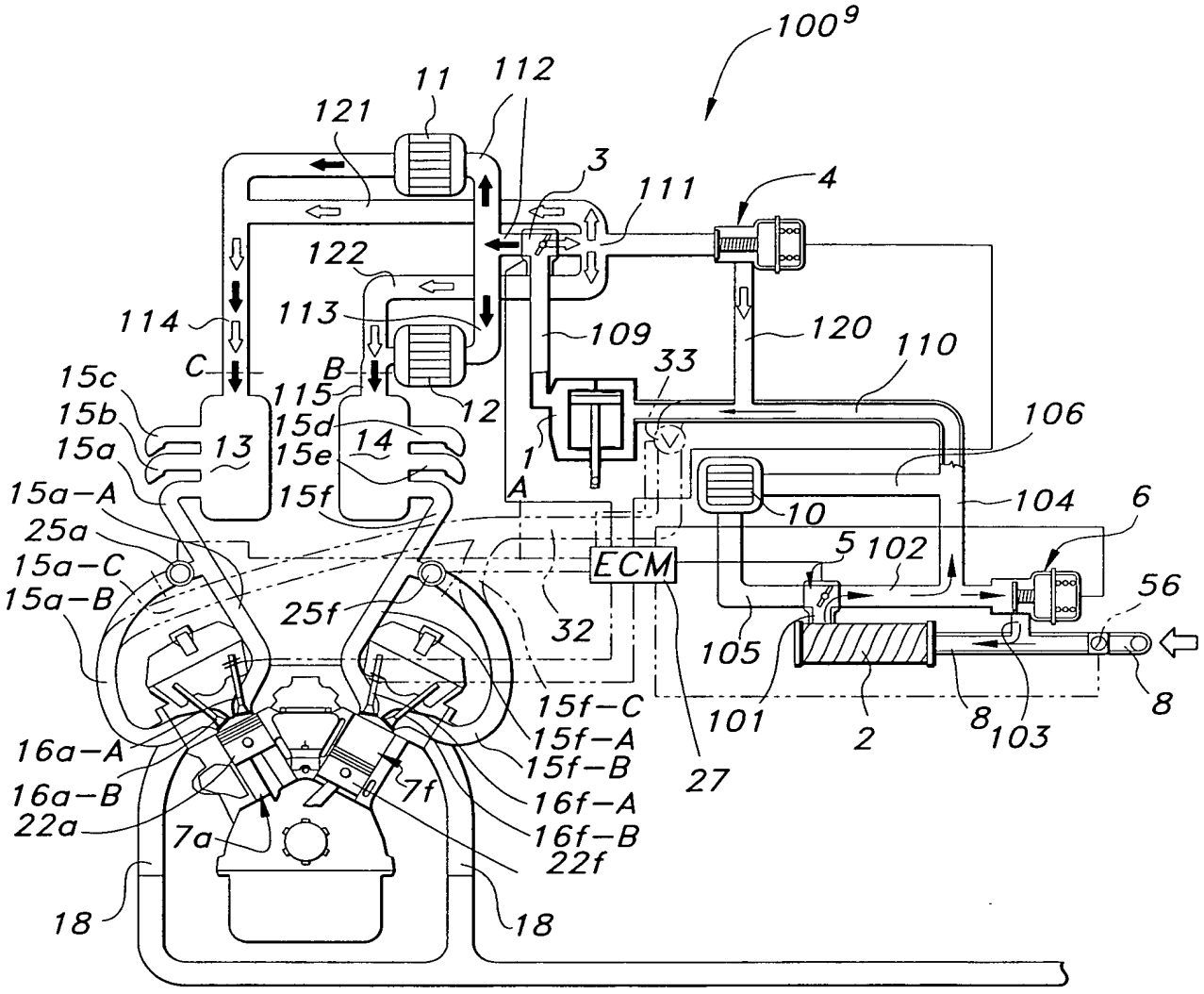

100⁹
11
112
121
3
111
4
122
114
113
109
120
110
C
B
33
15c
15b
15a
115
15d
15e
13
14
12
1
A
106
15a–A
15f
10
104
6
25a
15a–C
15a–B
ECM
5
102
56
25f
32
105
15f–C
15f–A
15f–B
16f–A
16f–B
22f
101
27
2
8
103
8
16a–A
16a–B
22a
7a
7f
18
18

FIG 15

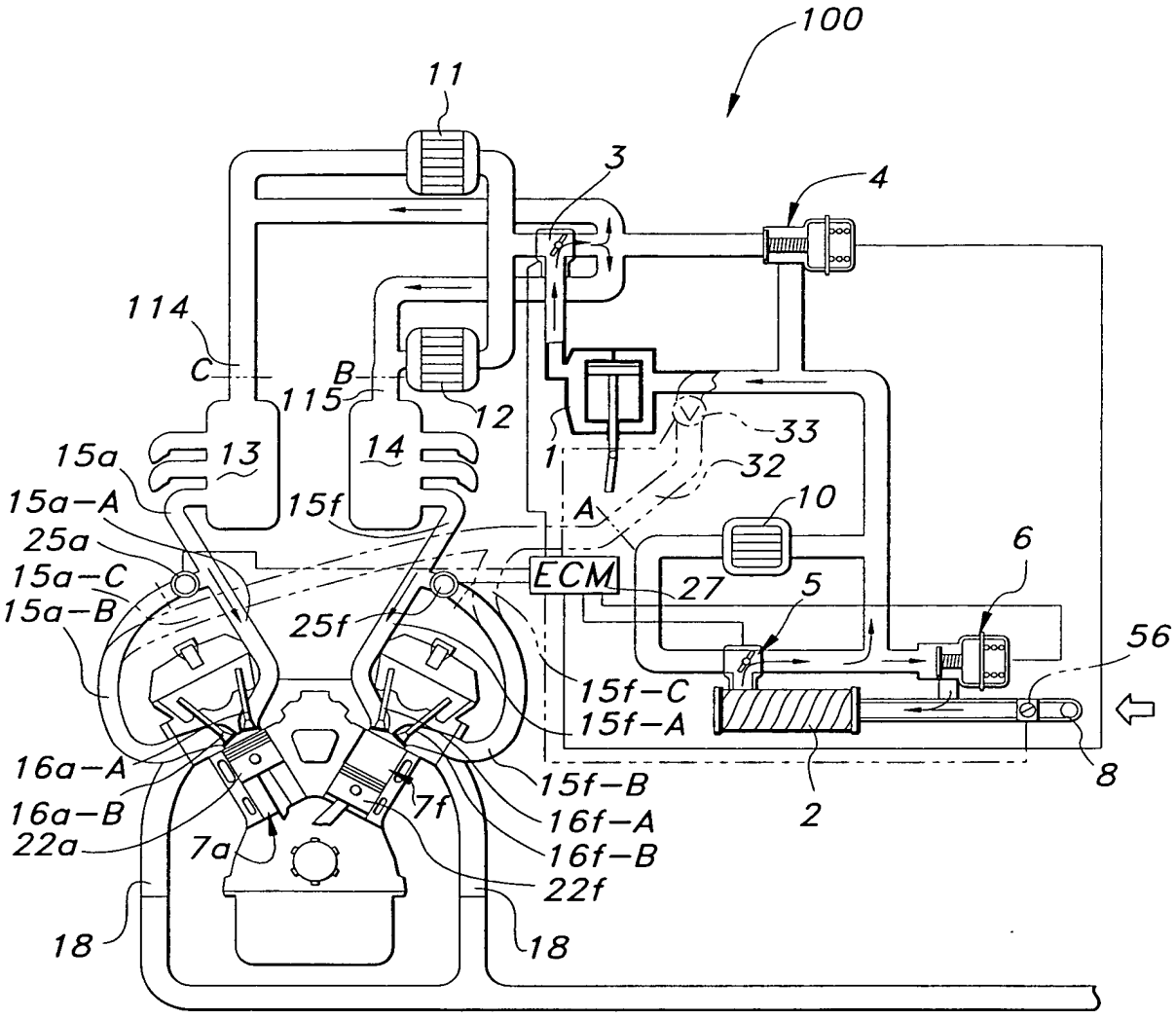

100
11
3
4
114
C
B
115
12
33
1
32
15a
13
14
10
15a-A
15f
A
25a
6
15a-C
ECM
27
5
15a-B
25f
56
15f-C
15f-A
16a-A
15f-B
8
16a-B
7f
16f-A
2
22a
7a
16f-B
22f
18
18

FIG 16

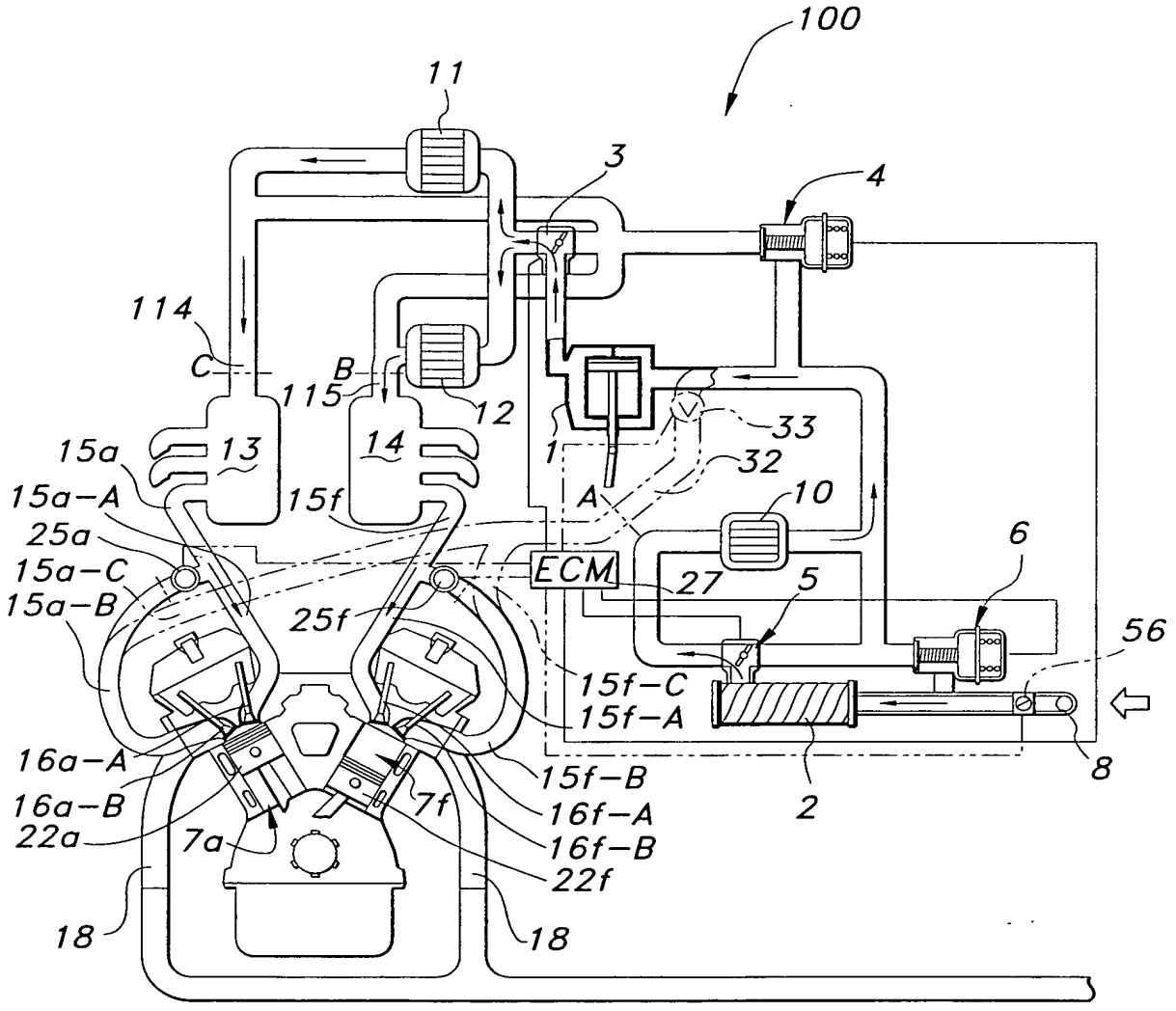

100
11
3
4
114
C
B
115
12
33
32
1
A
10
15a
13
14
15f
15a-A
25a
15a-C
15a-B
ECM
27
5
6
56
25f
15f-C
15f-A
8
2
16a-A
16a-B
22a
7a
7f
15f-B
16f-A
16f-B
22f
18
18

FIG 17

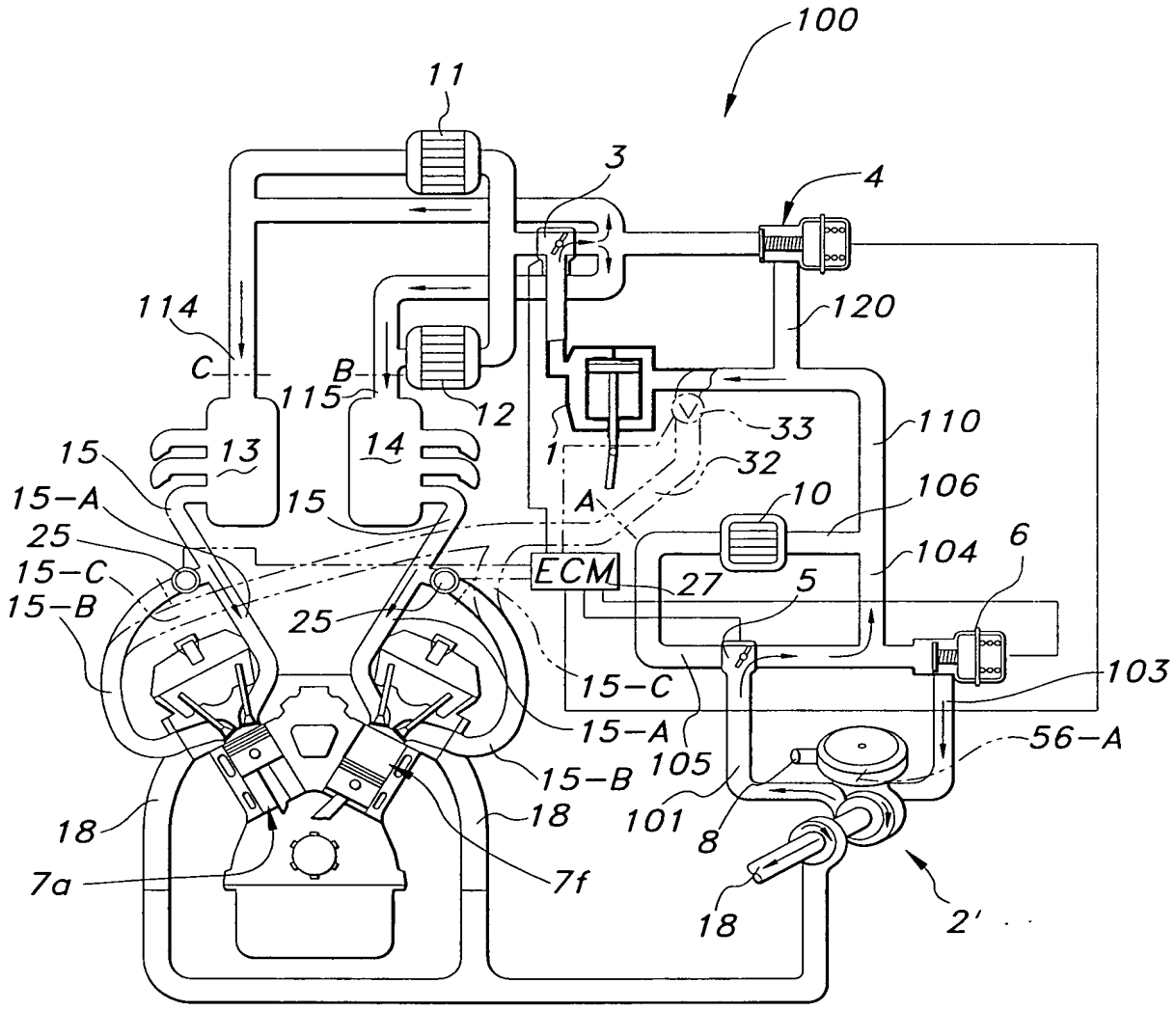

100
11
3
4
114
C
B
115
12
120
110
33
32
1
A
10
106
104
6
ECM
27
5
103
15
15-A
25
15-C
15-B
13
14
15
25
15-C
15-A
15-B
105
56-A
101
8
18
18
18
7a
7f
2'

FIG 18

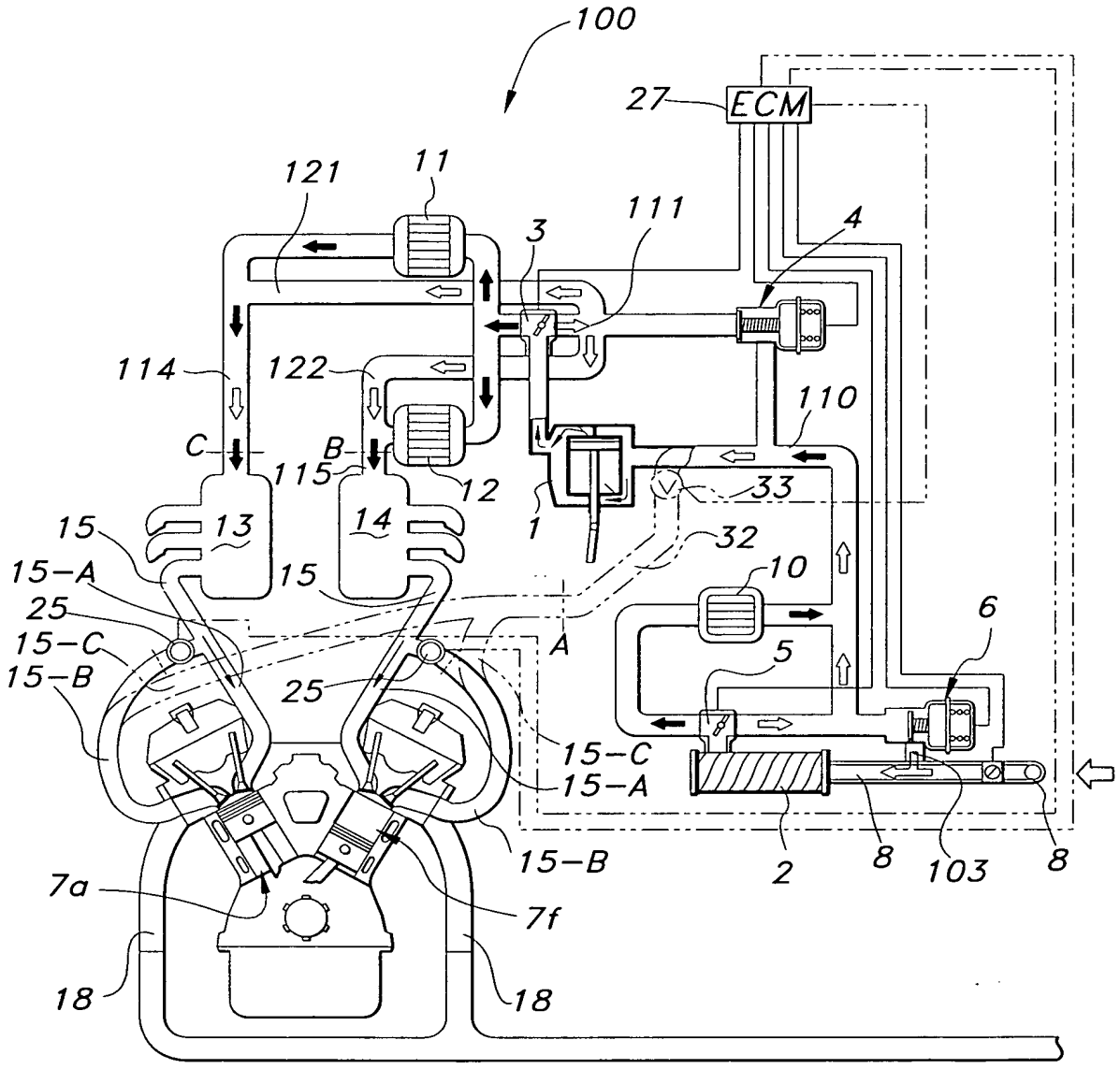

100
27
ECM
121
11
111
3
4
114
122
110
C
B
115
12
1
33
32
10
15
13
14
15
15-A
25
15-C
15-B
A
6
5
25
15-C
15-A
15-B
2
8
103
8
7a
7f
18
18

FIG 19

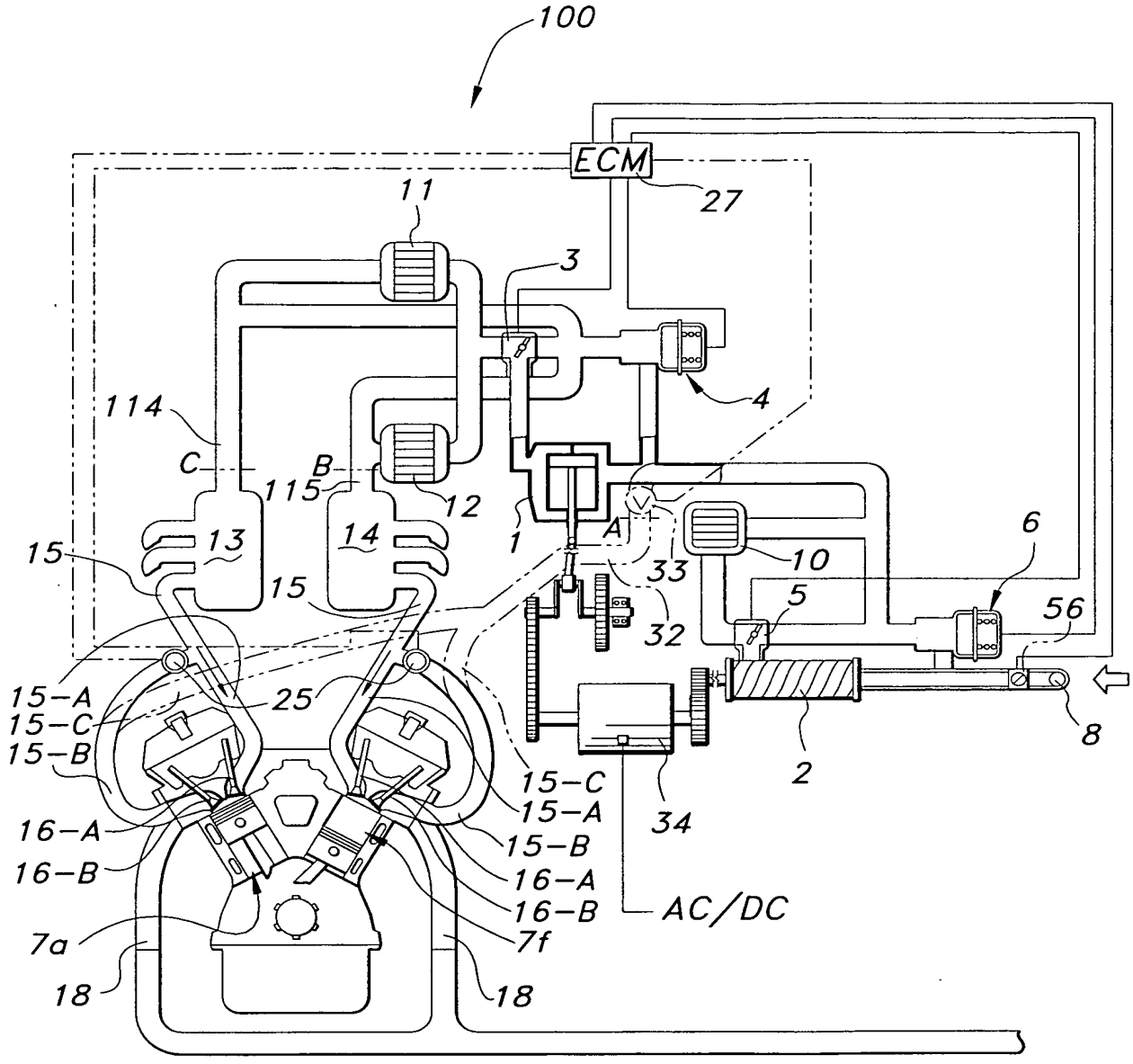

100
ECM
27
11
3
4
114
C
B
115
12
1
A
13
14
15
15
10
33
6
5
56
32
15-A
15-C
15-B
25
8
2
15-C
15-A
15-B
16-A
16-B
34
AC/DC
7a
7f
18
18

FIG 20

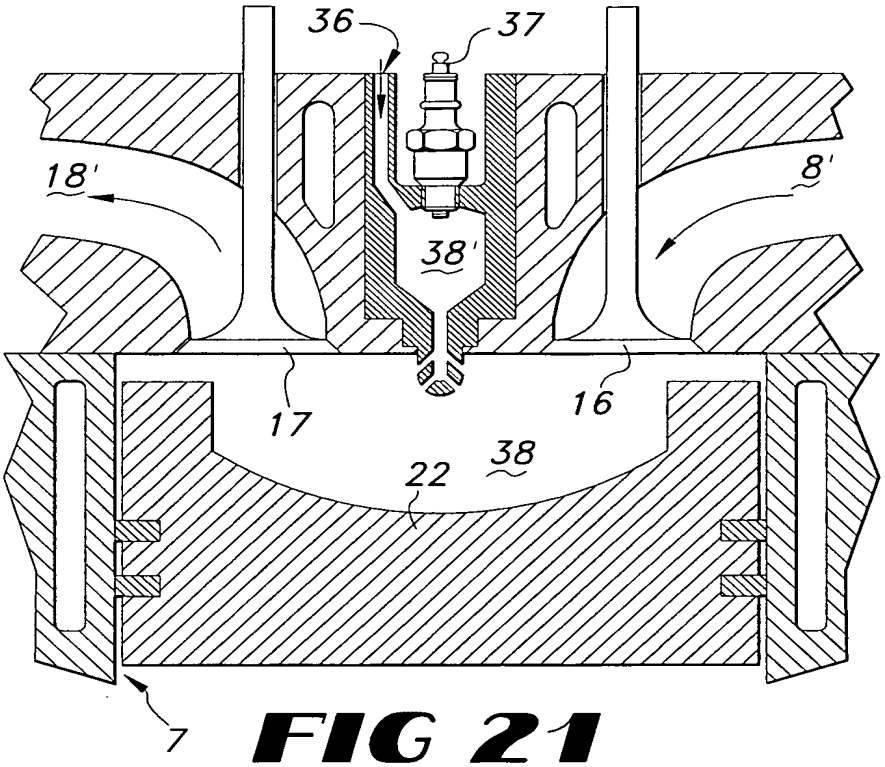


FIG 21

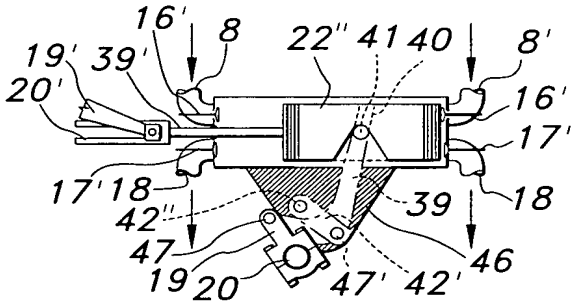


FIG 23

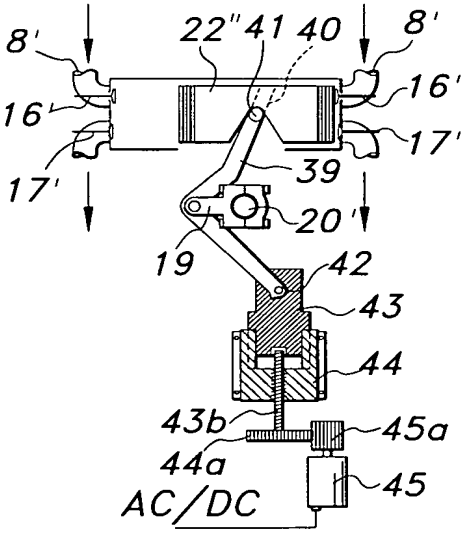


FIG 22

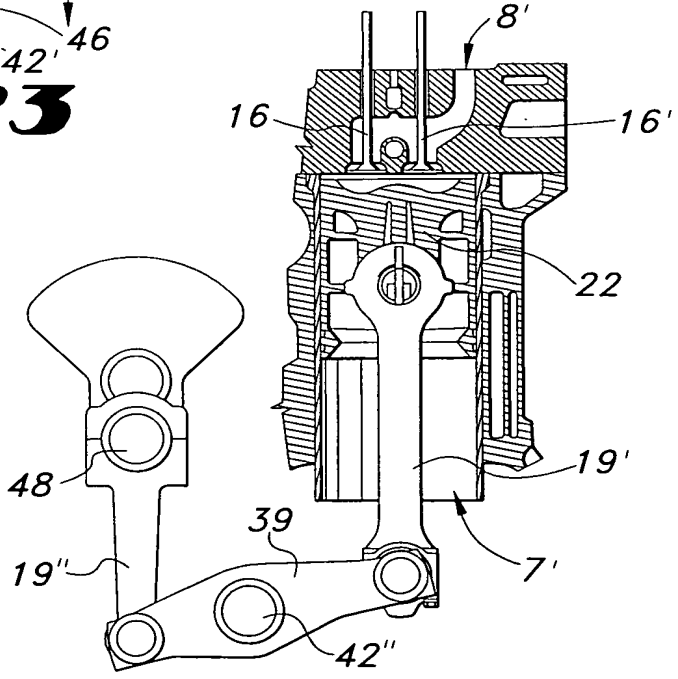


FIG 24

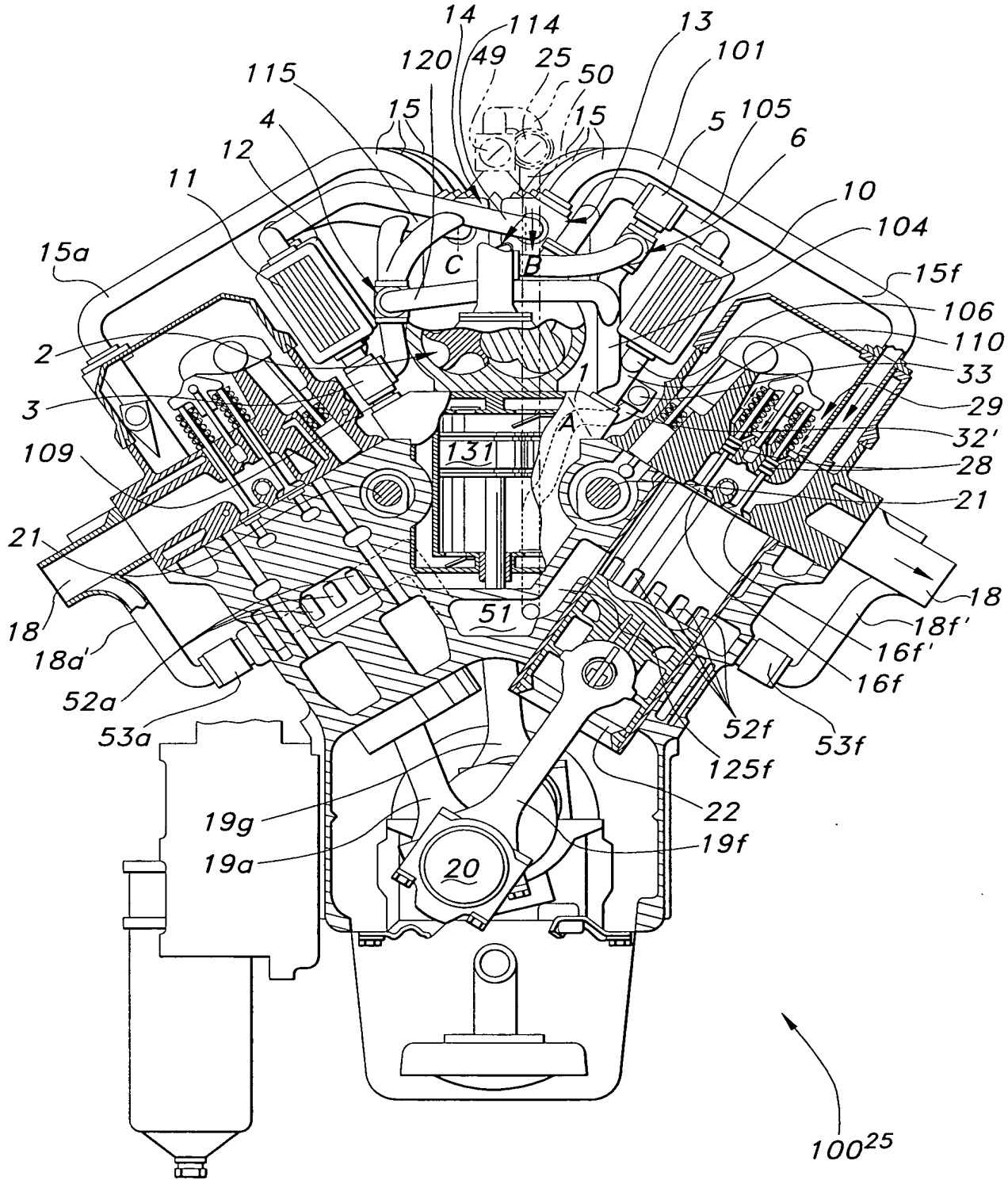

14
114
13
120
49
25
101
115
50
15
15
105
4
5
6
12
11
10
104
15a
C
B
15f
106
2
110
1
33
3
A
29
32'
109
131
28
21
21
18
51
18
18f'
18a'
16f'
52a
16f
53a
52f
53f
125f
19g
22
19a
19f
20
100

FIG 25

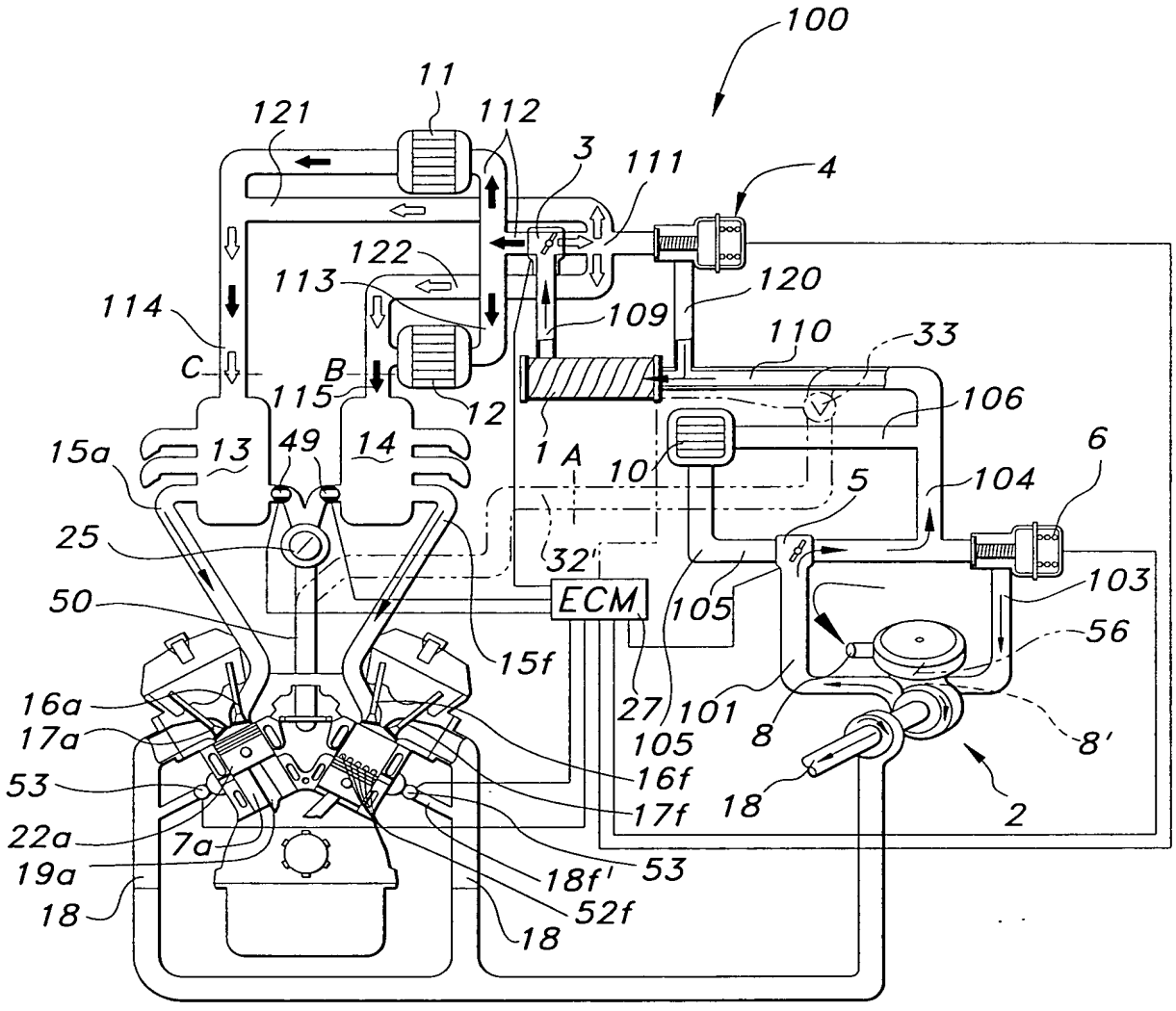

100
11
121
112
3
111
4
122
113
120
114
109
110
33
C
B
115
12
106
1 A
10
6
15a
13
49
14
5
104
25
32'
ECM
103
50
105
56
15f
27
101
16a
105
8
8'
17a
16f
53
17f
18
2
22a
7a
18f'
53
19a
52f
18
18

FIG 26

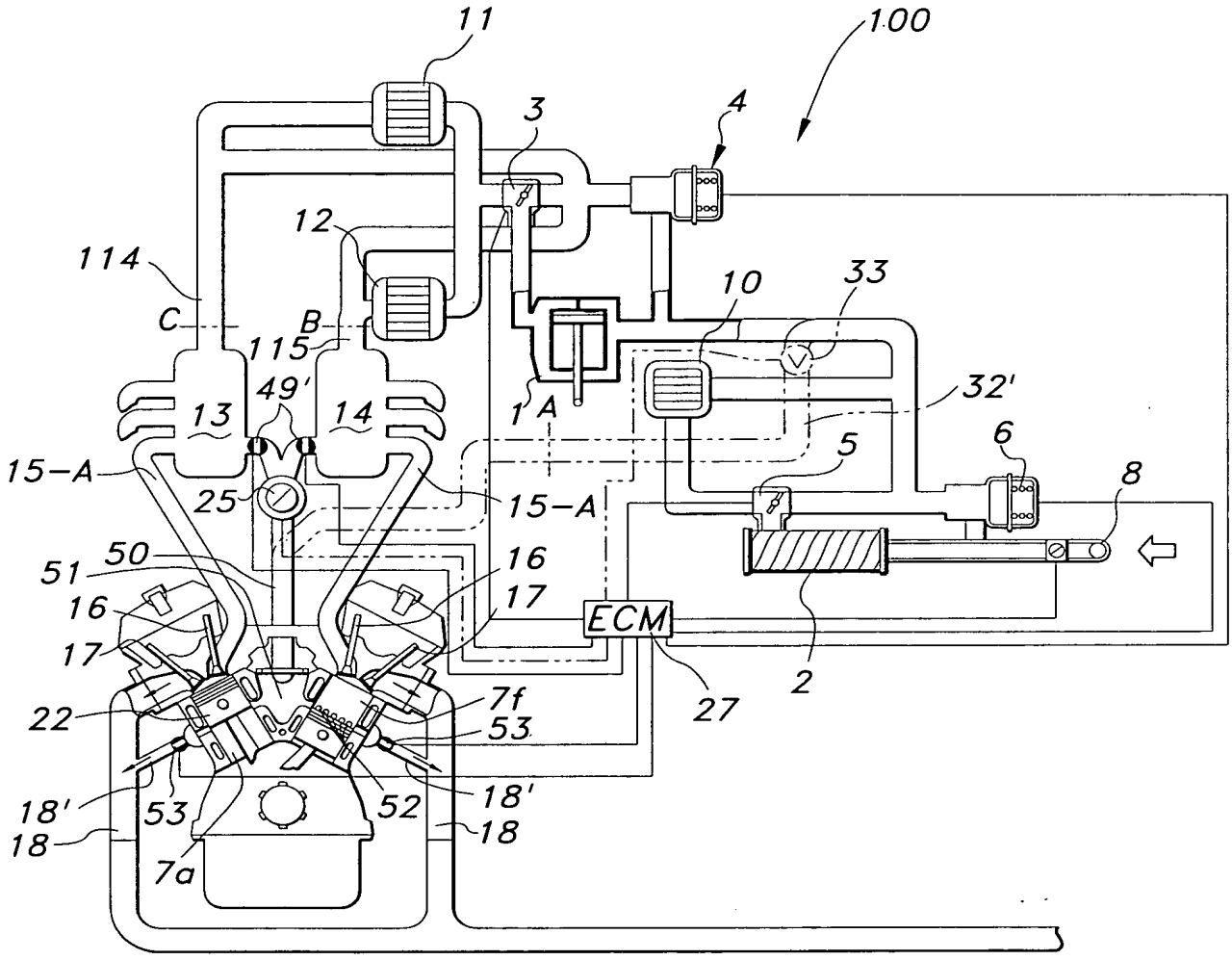

11
100
3
4
12
114
C
B
115
49'
13
14
10
33
1'A
32'
6
5
8
15-A
25
15-A
50
51
16
17
16
17
ECM
2
27
22
7f
53
18'
53
52
18'
18
18
7a

FIG 27

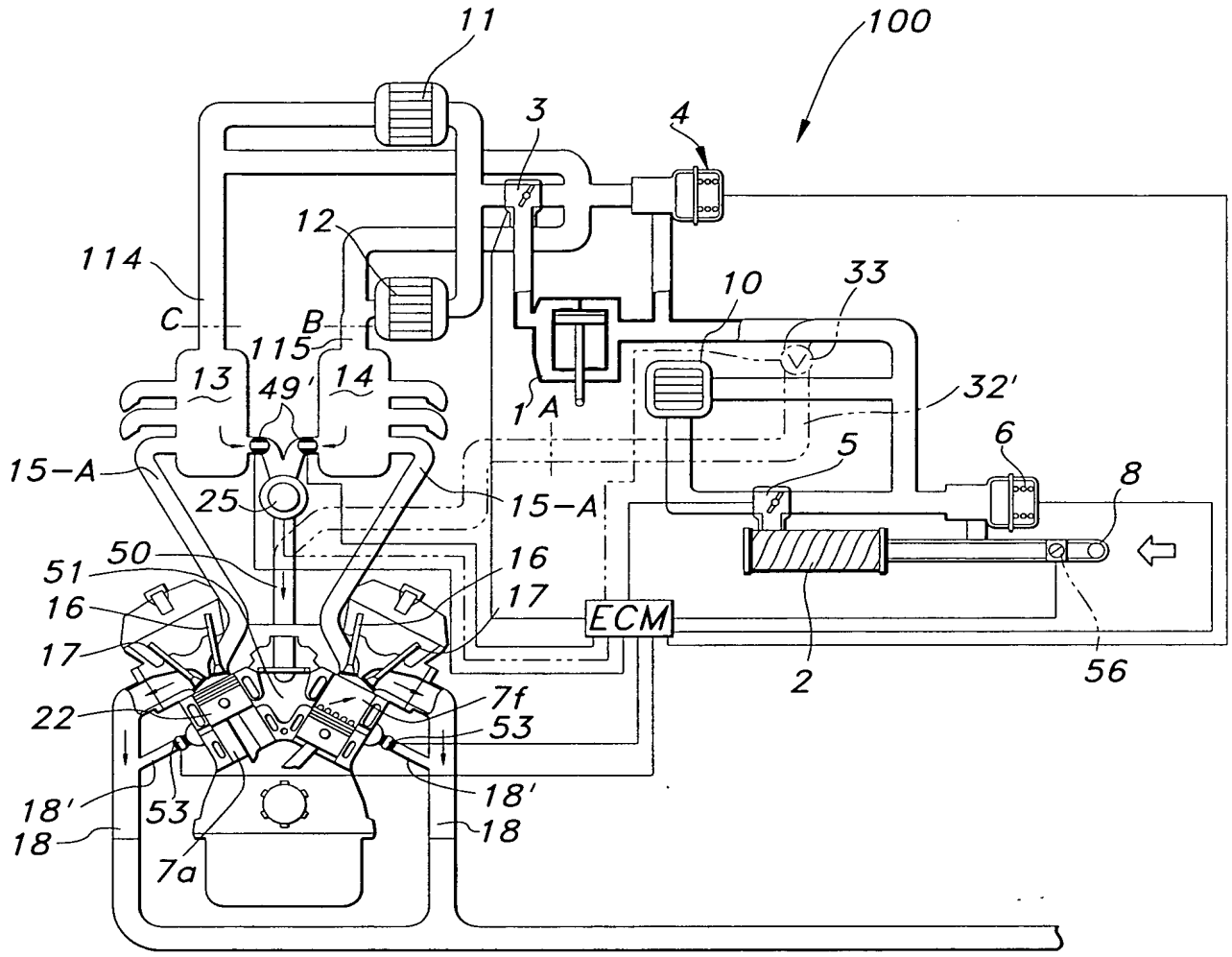

11
100
3
4
12
114
C
B
115
13
49'
14
10
33
1'
A
32'
6
5
8
15-A
25
15-A
50
51
16
17
16
17
ECM
2
56
22
7f
53
18'
53
18'
18
18
7a

FIG 28

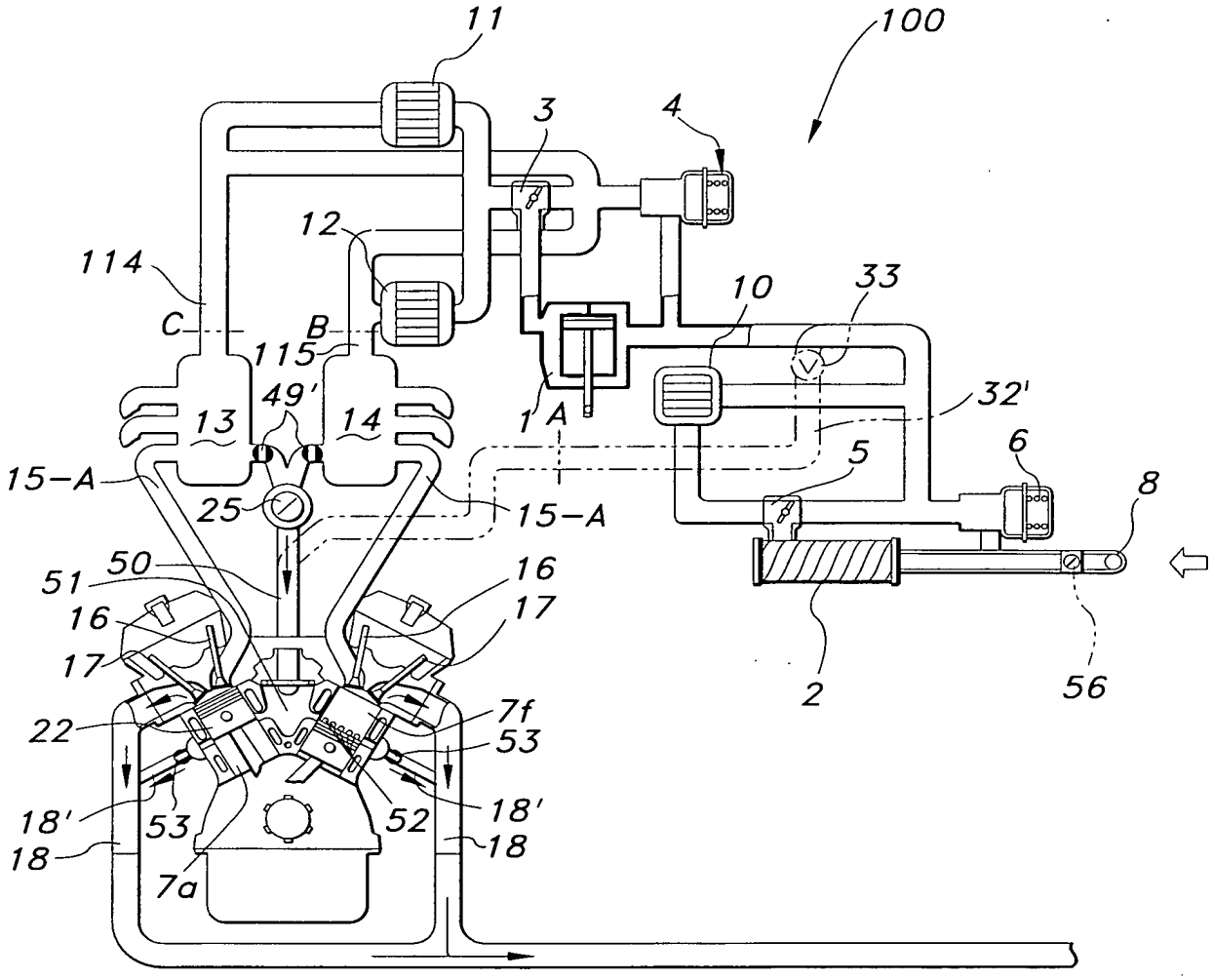

11
100
3
4
12
114
C
B
115
49'
13
14
1'
A
10
33
32'
6
5
8
15-A
25
15-A
50
51
16
17
16
17
22
7f
53
18'
53
52
18'
18
18
7a
2
56

FIG 29

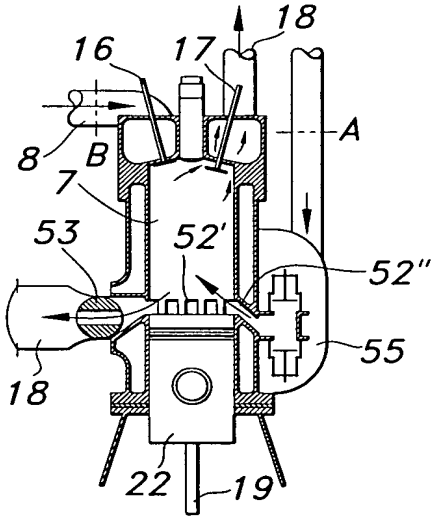

18
16
17
A
8
B
7
53
52'
52"
55
18
22
19

FIG 30

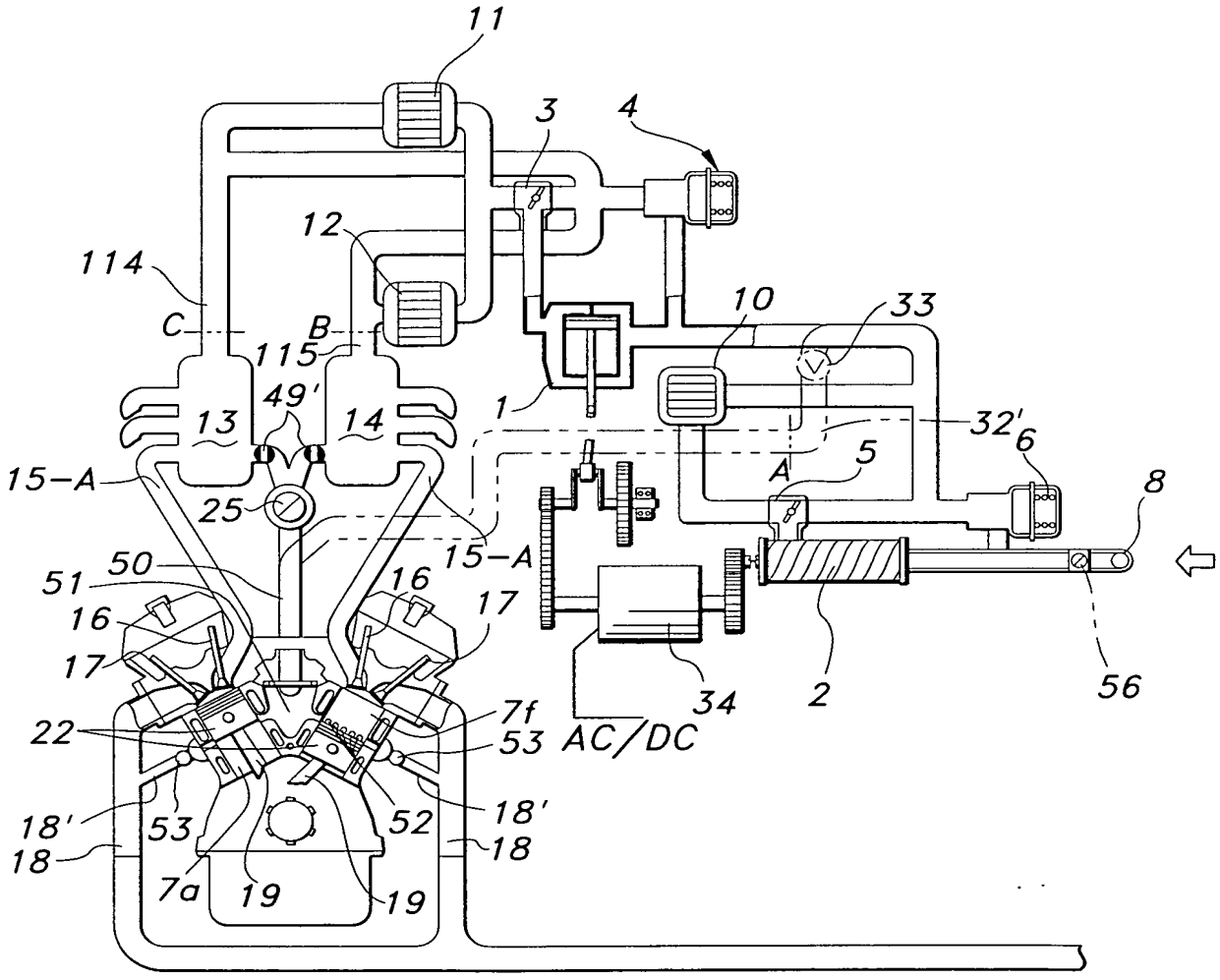

11
3
4
12
114
C
B
115
49'
13
14
1
10
33
32'
6
5
A
8
15-A
25
15-A
50
51
16
17
16
17
22
7f
53
AC/DC
34
2
56
18'
53
52
18'
18
18
7a
19
19

FIG 31

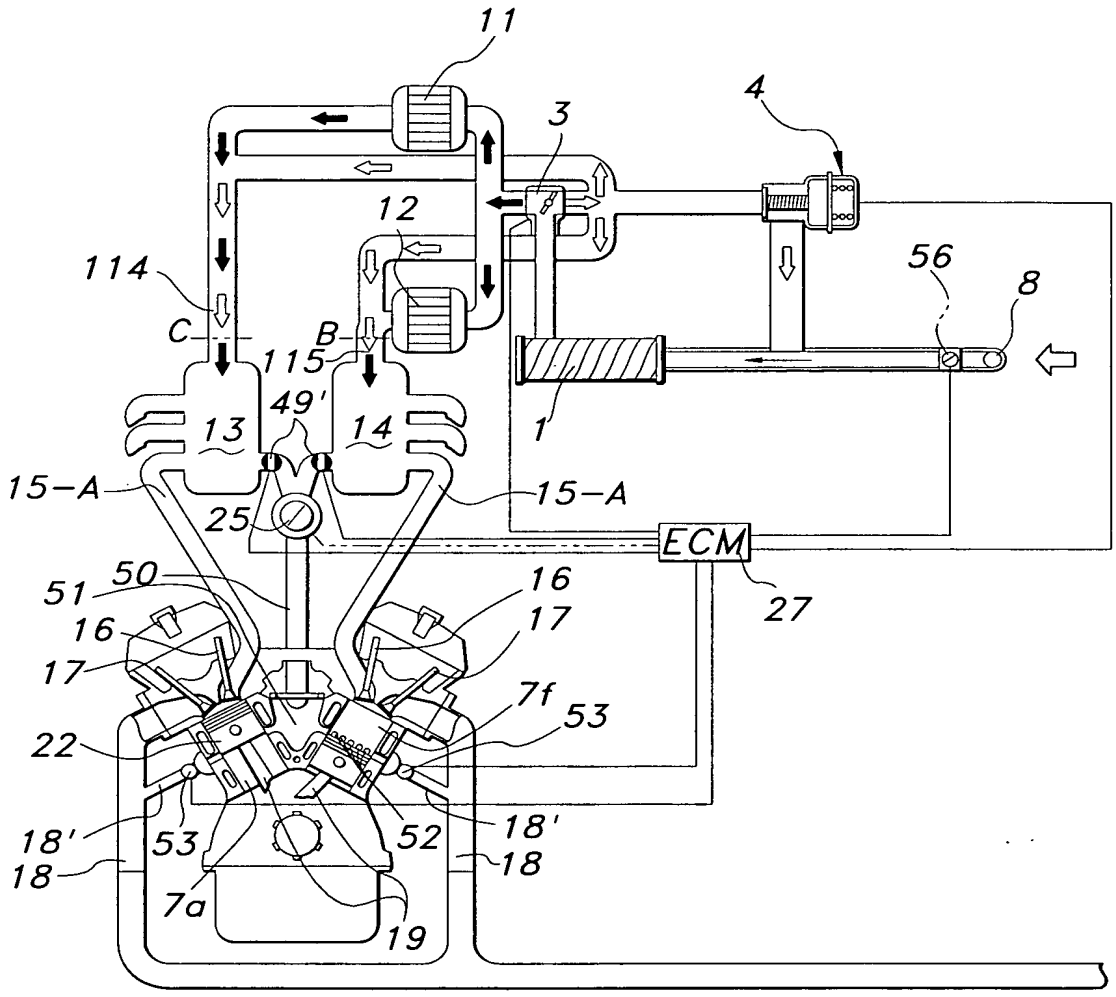

11
4
3
12
114
56
8
C
B
115
49'
13
14
1
15-A
15-A
25
ECM
27
51
50
16
17
16
17
7f
53
22
18'
53
52
18'
18
18
7a
19

FIG 32

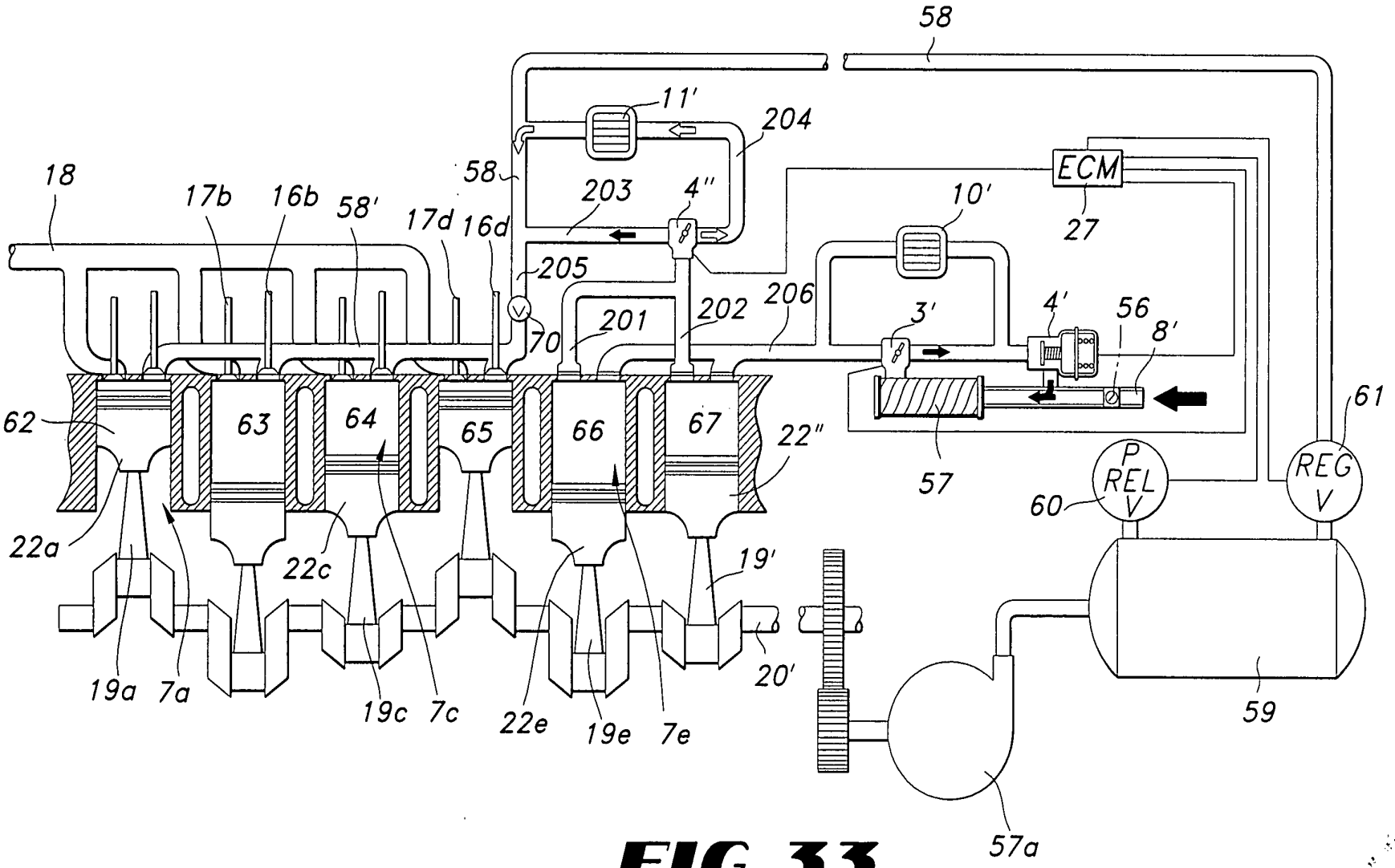

58
11'
204
58
203
4''
ECM
27
10'
18
17b
16b
58'
17d
16d
205
206
3'
4'
56
8'
70
201
202
62
63
64
65
66
67
22''
57
61
P REL V
REG V
60
22a
22c
19'
19a
7a
19c
7c
22e
19e
7e
20'
59
57a

FIG 33

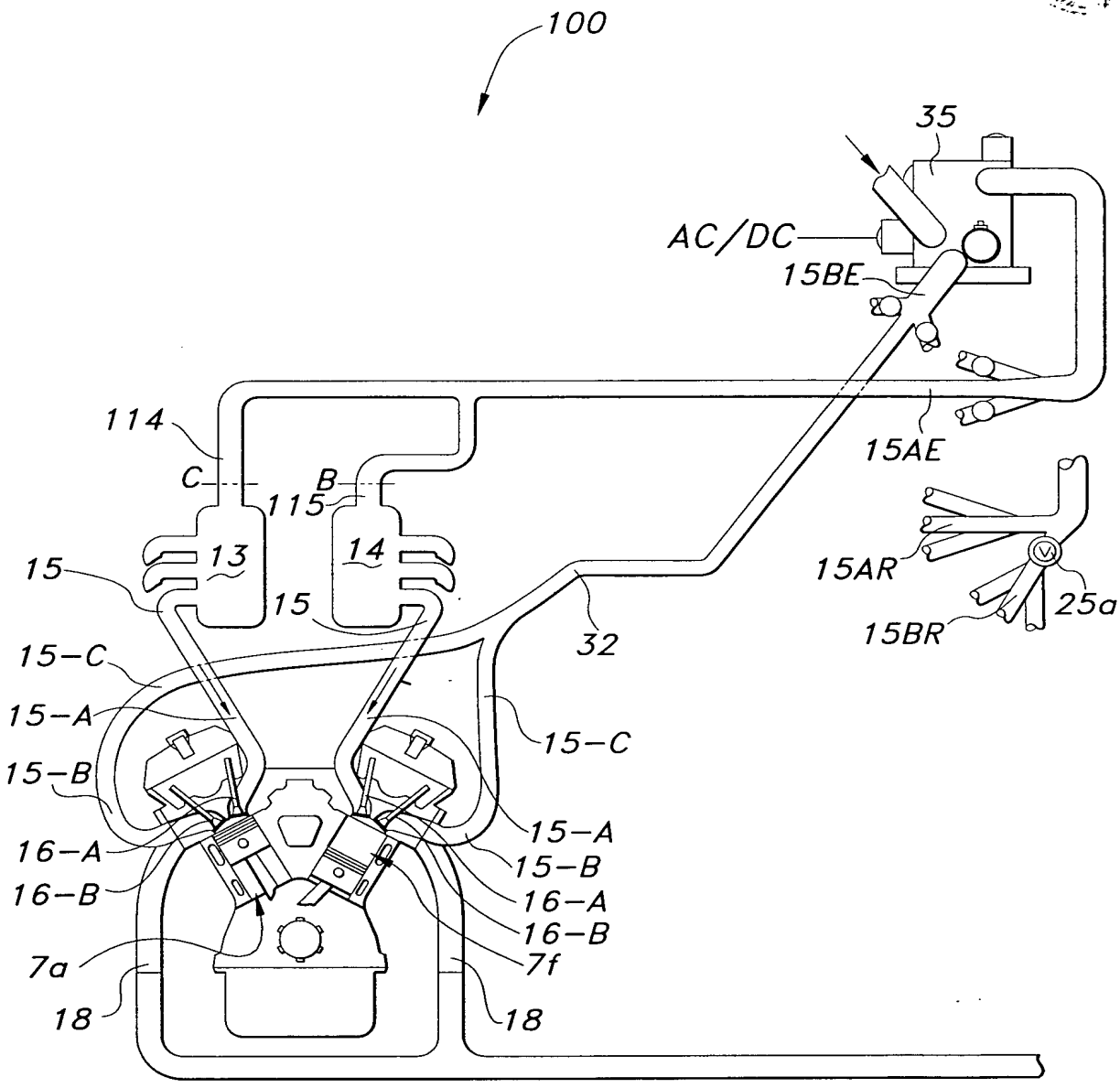

100
35
AC/DC
15BE
15AE
15AR
25a
15BR
114
C
B
115
13
14
15
15
32
15-C
15-A
15-B
16-A
16-B
7a
18
15-C
15-A
15-B
16-A
16-B
7f
18

FIG 34

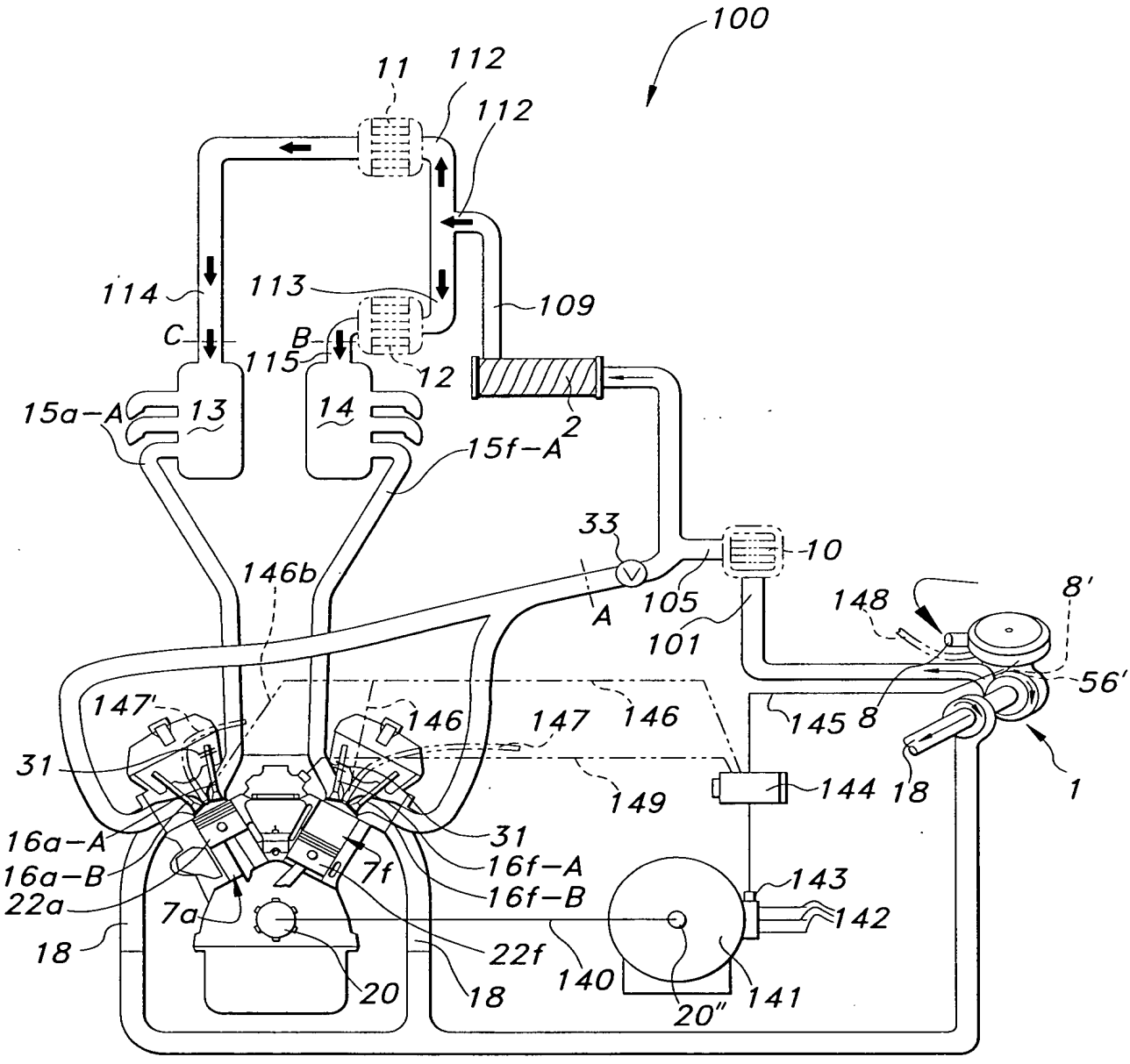

100
11
112
112
114
113
109
C
B
115
12
2
15a–A
13
14
15f–A
33
10
146b
A
105
101
148
8'
56'
147'
146
147
146
145
8
31
149
144
18
1
16a–A
16a–B
22a
18
7a
7f
31
16f–A
16f–B
143
142
22f
140
141
20
18
20''

FIG 35

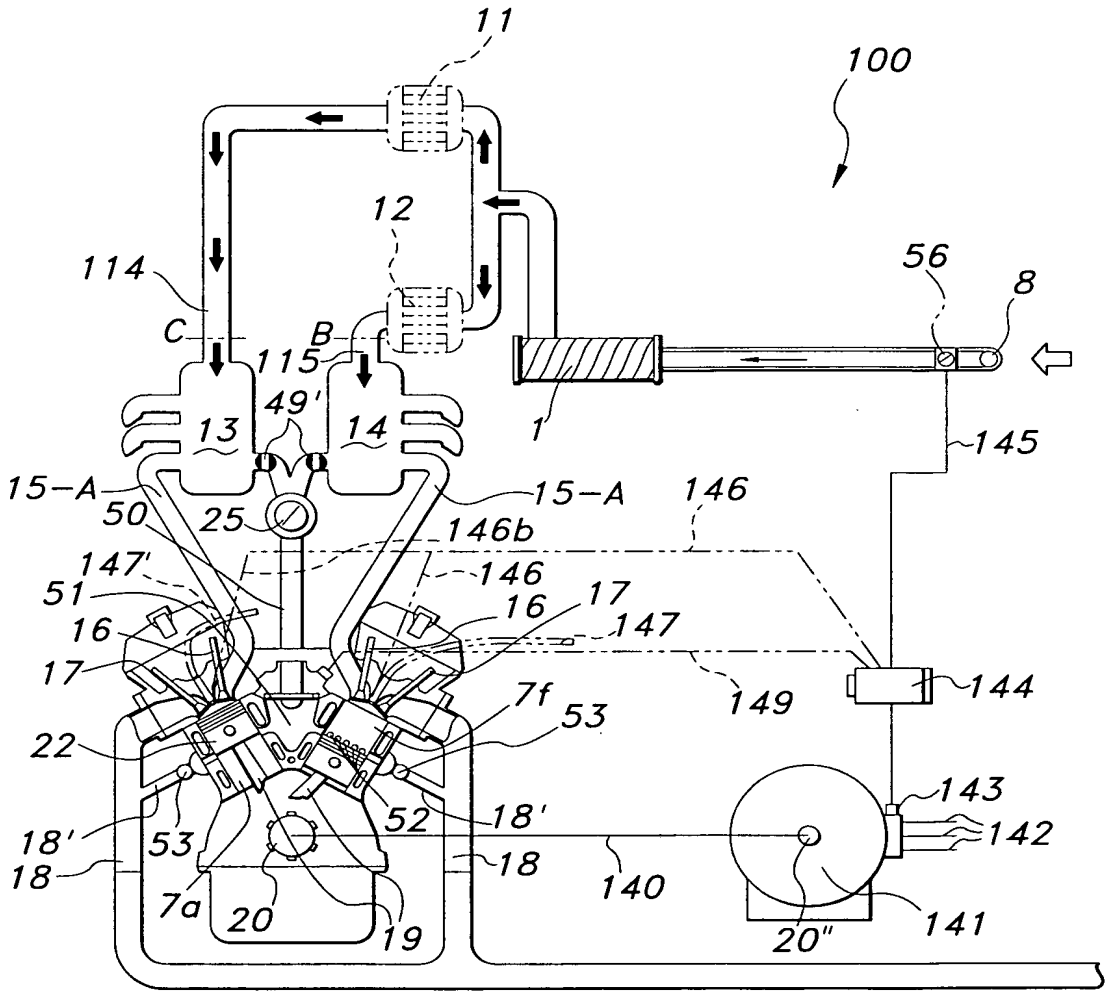

11
100
12
114
56
8
C
B
115
49'
13
14
1
145
15-A
15-A
146
50
25
146b
147'
146
51
16
17
147
16
17
149
144
7f
53
22
143
52
18'
18'
53
142
18
18
140
7a
20
19
20"
141

FIG 36